76-02A

TYPE

76-02A DUAL TRACE PLUG-IN

Instruction Manual

Serial No. 1834

This Plug-in Module is designed for use with the Fairchild Type 765 Series Oscilloscope. Insert this Manual into the binder you received with the Type 765 Series Instruction Manual.

FAIRCHILD
DU MONT LABORATORIES
DIVISIONS OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

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TABLE OF CONTENTS

Section	Title	Page
1.	**TECHNICAL SUMMARY**	
1-1	Introduction	1-1
1-2	Technical Summary	1-1
2.	**OPERATING INSTRUCTIONS**	
2-1	First Time Operation	2-1
2-2	Applying a Signal	2-1
2-3	Balance Adjustments	2-1
2-4	Setting Gain of Dual Trace Amplifier	2-1
2-5	Input Selector Switch	2-3
2-6	Obtaining a Display	2-3
2-7	Additional Hints	2-3
2-8	Use of Probes	2-5
2-9	Dual-Trace Operation	2-5
2-10	Dual-Trace Triggering	2-5
2-11	Dual X-Y Displays	2-6
2-12	Voltage Measurements	2-6
2-13	Measuring Short Rise Times	2-8
3.	**CIRCUIT DESCRIPTION**	
3-1	Introduction	3-1
3-2	Input Amplifier Circuit Description	3-1
3-3	Electronic Switch Circuit Description	3-2
3-4	Common Deflection Amplifier	3-4
4.	**PERFORMANCE ASSURANCE TEST**	
4-1	Maintenance Check to Assure Performance	4-1
4-2	Checking Sensitivity of Channels A & B	4-1
4-3	Checking Pulse Response of Channels A & B	4-1
4-4	Checking Bandwidth of Channels A & B	4-1
4-5	Checking Mode Switch	4-2
5.	**MAINTENANCE AND RECALIBRATION**	
5-1	Introduction	5-1
5-2	Removal and Replacement of Parts	5-1
5-3	Servicing Hints	5-1
5-4	Gaining Access to Chassis	5-3
5-5	Test Equipment Required for Service Adjustments	5-3
5-6	DC Bal Adjustment	5-3
5-7	Gain Adj	5-4
5-8	Trig DC Level	5-4
5-9	High-Frequency Adjustments	5-4
5-10	Input Capacitance Standardization and Attenuator Adjustment	5-4
5-11	Set Attenuator Balance	5-5
6.	**PARTS LISTS AND SCHEMATICS**	
6A	Electrical Parts List	6-1
6B	Spare Parts List	6-5
	List of Recommended Vendors	6-7

TABLE

Figure	Title	Page
5-1	Attenuator Compensation Trimmers	5-5

ILLUSTRATIONS

Figure	Title	Page
1-1	Type 76-02A Dual Trace, Wide Band, High Gain Plug-in	1-0
–	Type 76-02A Frequency Response Curve	1-1
2-1	Function of Controls and Connectors	2-2
2-2	Type 76-02A Calibrator Display	2-4
2-3	Peak-to-Peak Voltage Measurements	2-7
2-4	Instantaneous Voltage Measurement with respect to Ground (or some other Reference Potential)	2-7
3-1	Type 76-02A Input Circuit, Functional Block Diagram	3-1
3-2	Type 76-02A Channels A and B Functional Block Diagram	3-2
3-3	Type 76-02A Electronic Switching Circuit Functional Block Diagram	3-3
3-4	Type 76-02A Y Deflection Amplifier Functional Block Diagram	3-4
5-1	Type 76-02A Over-All System Block Diagram	5-2
5-2	Test Setup for Adjusting Input Capacitance	5-5
5-3	Standardizing the Input Capacitance	5-5
5-4	Right Side View Showing Transistors and Attenuator Trimmers	5-6
5-5a	Left Side View Showing Pots and Trimmer Adjustments	5-7
5-5b	Left Side View Showing Transistors and Nuvistors	5-8
6-1	Front Panel Replaceable Parts	6-0

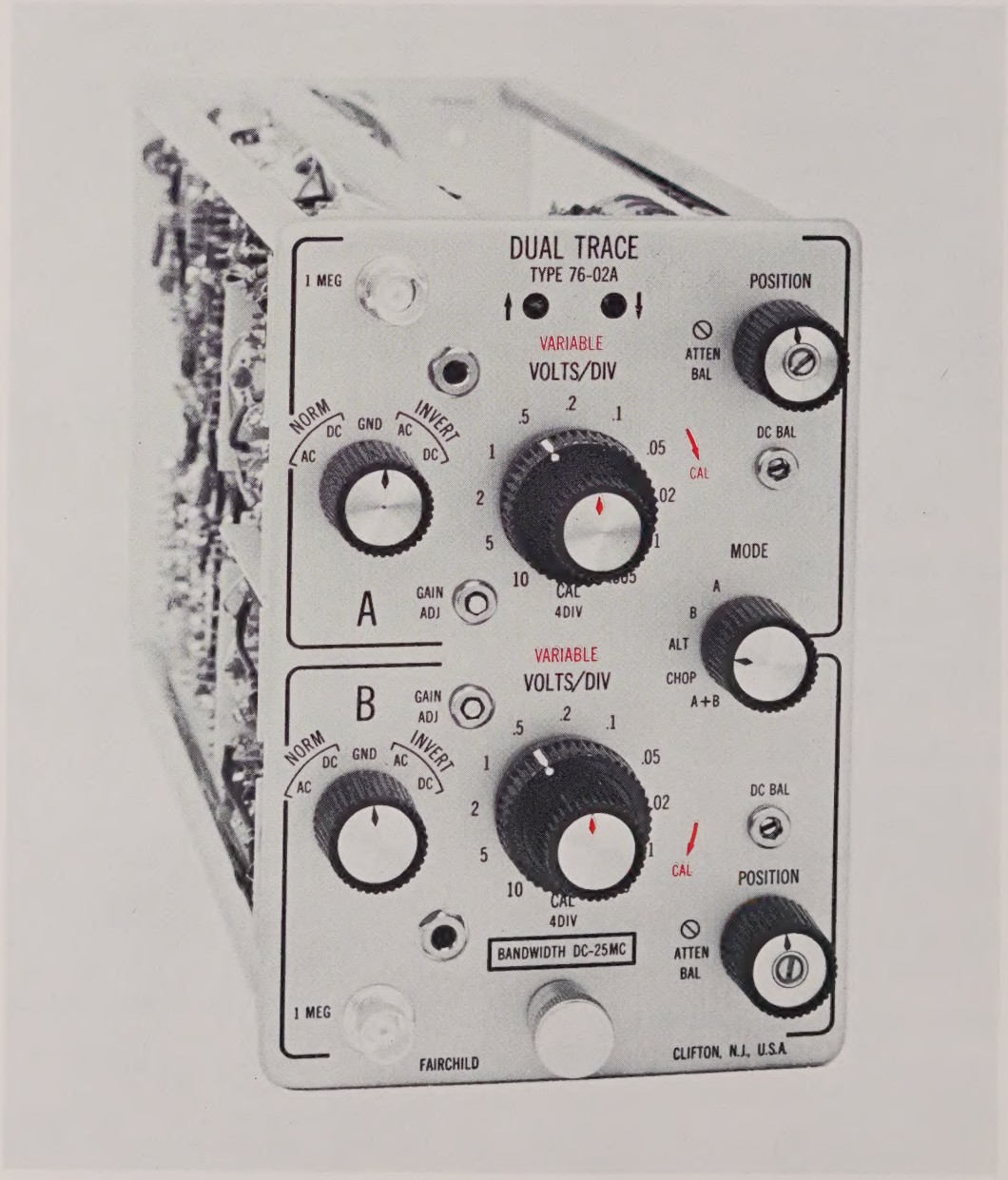


Figure 1-1. Type 76-02A Dual Trace, Wide Band, High Gain Plug-In

SECTION 1
TECHNICAL SUMMARY

1-1. INTRODUCTION

The Type 76-02A Amplifier is a dual-channel amplifier with a bandwidth of 25 megacycles and a sensitivity of 5 millivolts/division. It enables the user to obtain two vertical signals on the screen simultaneously to display either channel individually. A 230-nanosecond delay is optional in this unit.

The sensitivity of the Type 76-02A Plug-in is variable from 5 millivolts/division to 10 volts/division in 11 steps of 1, 2, and 5 sequence. Accuracy is within 3% at each of the calibrated steps. All frequency measurements are made at 4-division scan.

The VARIABLE gain control, located concentrically with the VOLTS/DIV switch, has a range of greater than 1:2½. This VARIABLE gain control provides continuous overlap between steps of the attenuator (VOLTS/DIV) switch. A detented stop position is provided when the VARIABLE gain control is set to CAL.

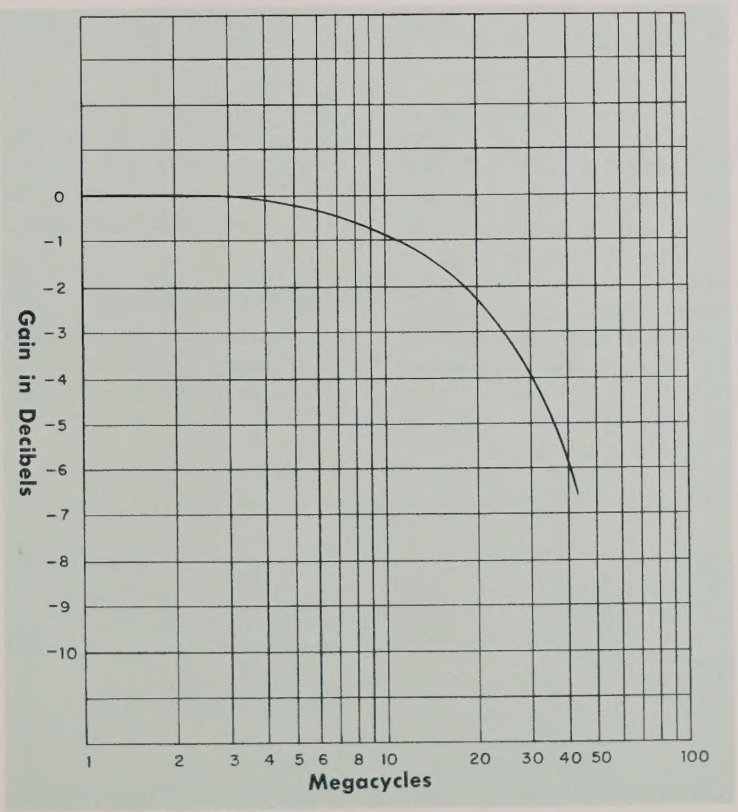
A MODE switch is provided which enables the selection of either Channel A or Channel B for separate display or the sum of both channels for combined display. In addition, ALTernate or CHOPped modes of operation are available. Use of the polarity inversion switch may give A minus B or B minus A presentation when MODE switch is set to A + B.

A front-panel screwdriver GAIN ADJ control is provided on each channel to normalize gain between channels and between the Plug-in and the Main Frame.

The Type 76-02A Amplifier is primarily intended for use in the Y cavity of the Type 765 Series Oscilloscopes. However, this Amplifier may be inserted in the X cavity. When used in this application, the amplifier sensitivity and available scan are reduced by a factor of 2 to 1.

1-2. TECHNICAL SUMMARY

The electrical characteristics of the Type 76-02A Dual Trace Amplifier are listed in the performance specifications which follow.



Type 76-02A Frequency Response Curve

SPECIFICATIONS

Y AMPLIFIER

Bandwidth

Direct Coupled: DC to 25 megacycles, down 3 db at 25 megacycles (referenced to 50 Kc measured at 4 div p-p)

Capacitively Coupled: Low frequency cutoff is 10 cycles

Rise Time: Less than 15 nanoseconds driven from a 25-ohm source

Sensitivity

5 mv/div to 10 v/div in 11 steps of 1, 2, and 5 sequence when VARIABLE gain control is set to CAL; accurate to within ±3% when set on any one step

The VARIABLE gain control permits 2½ to 1 continuous sensitivity adjustments between the VOLTS/DIV steps and extends the 10 volts/div range to 25 volts/div

Input Impedance

1 megohm shunted by 40 pf

Input Selector Switch

Each channel is provided with a 5-position switch which enables selection of AC or DC coupling with NORMal or INVERTed polarity; grounds amplifier input grid and disconnects input signal when set to GND

Calibration

The attenuator includes a CAL position which applies a line frequency square wave signal directly to the input of the Y amplifier to aid in standardizing gain (Cal: 4 div)

Signal Delay (Optional)

A 230-nanosecond balanced distributed bifilar helical delay line is provided. This delay is sufficient to view base line and the leading edge of the signal triggering the time base

Internal Trigger

An internal trigger take-off amplifier precedes the delay line. This signal is referenced to ground when the trace is positioned to screen center via factory adjustment of the TRIG DC LEVEL control

Operational Modes

The following displays are available:

1. A only
2. B only
3. A & B switched alternately
4. A & B time shared (Chopped)
5. A + B (Invert switch permits A-B or B-A presentation)

In chopped operation, the electronic switching rate is greater than 60 Kc; each channel is nominally on 6 μsec and off 9 μsec including the blanking time. Switching transients are automatically blanked

Beam Position Indicators

Two indicator lamps are located on the front panel to alert the operator as to the direction of the beam when it is positioned off the screen

SECTION 2
OPERATING INSTRUCTIONS

2-1. FIRST TIME OPERATION (Figures 2-1 and 2-2)

Unless otherwise designated, it is presumed that the Type 76-02A Plug-in Amplifier is inserted in the Y cavity (left-hand side) and the Type 74-11A Time Base Plug-in is inserted in the X cavity (right-hand side) of the Main Frame. If the Type 76-02A Plug-in unit is inserted in the X cavity of the Main Frame, it will provide horizontal deflection of the trace and the information must be translated accordingly. In the instructions which follow, capital letters within the text indicate front-panel controls, connectors, or settings.

The following illustrations are designed to aid the operator in becoming familiar with the oscilloscope:

Figure 2-1. Function of Controls and Connectors.

Figure 2-2. Type 76-02A Calibrator Display.

2-2. APPLYING A SIGNAL

The signal (or signals) to be displayed is applied to either (or both) input connector on the front panel. To insure proper performance, the signal should be applied through a shielded cable, with the shield connected to the chassis of both the oscilloscope and the signal source.

Accessory Probes are available for use with the Type 76-02A Amplifier and are listed in the Type 765 Series Oscilloscope Instruction Manual.

2-3. BALANCE ADJUSTMENTS

a. DC Bal

If the DC balance of the Type 76-02A Amplifier is not properly adjusted, the reference trace on the screen will be depositioned when the VARIABLE control is rotated. To properly adjust the DC BAL front-panel screwdriver control for Channel A, proceed as follows:

1. Set VOLTS/DIV switch to 0.005, Input Selector switch to GND, and rotate VARIABLE control to its minimum gain setting.
2. Adjust the appropriate Time Base Plug-in controls to obtain a reference trace on the screen.
3. Using the POSITION control on the Type 76-02A Amplifier, position the trace to screen center (reference line).
4. Turn the VARIABLE control to the calibrated position and note any deflection.
5. Adjust the DC BAL control until the trace is positioned to the reference line established in step 3. Do *not* change the POSITION control setting.
6. Continue to adjust the DC BAL control until there is no depositioning of the trace when the VARIABLE control is rotated back and forth throughout its range.
7. Repeat above setup (steps 1 through 6) for Channel B.

Note: If the adjustment range of the front-panel DC BAL control is insufficient, refer to Section 5, Maintenance and Recalibration, for the complete factory Coarse and Fine DC BAL adjustment procedure.

b. Atten Bal

When the ATTEN BAL control (screwdriver control concentric with the POSITION knob) is properly adjusted, there will be no depositioning of the trace when the VOLTS/DIV control is activated. To adjust, proceed as follows:

1. Vary VOLTS/DIV switch from 0.005 to 0.1.
2. Adjust ATTEN BAL front-panel screwdriver control until there is no depositioning of the trace when switching the VOLTS/DIV control back and forth.
3. Check the 0.02 and the 0.005-volt ranges; readjust if necessary.
4. Repeat steps 1, 2, and 3 for Channel B.

2-4. SETTING GAIN OF DUAL TRACE AMPLIFIER

Whenever the Type 76-02A Amplifier is removed from the Main Frame and inserted in another, the front-panel screwdriver GAIN ADJ control must be reset. This procedure is necessary to compensate for difference in deflection plate sensitivities. In addition, if the Type 76-02A Amplifier is switched from the Y cavity to the X cavity of the same Main Frame, readjustment will be necessary since the difference in average deflection plate voltages between modules affects the over-all deflection sensitivity of the cathode-ray tube. To properly normalize the gain between channels or between the Plug-in unit and the Main Frame, proceed as follows:

1. Set both Channel A and B VOLTS/DIV switches to CAL and turn both VARIABLE controls to CAL.
2. Set MODE switch to A.
3. Adjust the sweep controls for a stable display.
4. Set Channel A front-panel screwdriver GAIN ADJ control for precisely 4 divisions of deflection.
5. Set MODE switch to ALT and adjust sweep rate for 2 mSEC/div.
6. Position the traces one on top of the other.
7. Adjust Channel B GAIN ADJ until only one trace may be observed (traces are superimposed).

VOLTS/DIV

One of two identical attenuators: calibrated from 5 mv/div to 10 volts/div in 11 steps; CAL position also provided

VARIABLE

One of two identical controls: provides a 1:2-1/2 variable adjustment permitting maximum gain and overlap of the VOLTS/DIV setting. A detented stop position is provided in CAL setting

Beam Position Indicators

INPUT

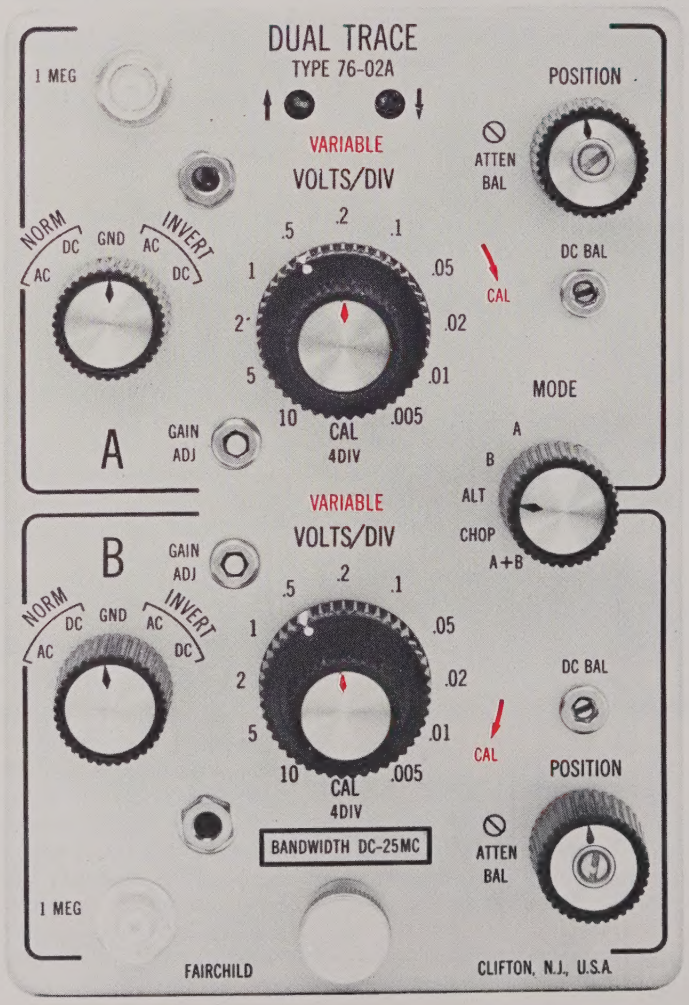
One of two identical BNC connectors: used to applying external signals to the associate channel amplifier via the MODE switch

INPUT SELECTOR

One of two identical switches: enables selection of AC or DC coupling with NORMal or INVERTed polarity; grounds amplifier input when set to GND

GAIN ADJ

One of two identical screwdriver controls: used for normalizing the associate channel amplifier to the Main Frame



JACK

For ground connection

POSITION

One of two identical controls: used to position the trace vertically

MODE

Switch: used to select the following dual-trace modes:

1. Channel A only
2. Channel B only
3. Channels A & B switched alternately
4. Channels A & B time-shared (Chop)
5. Algebraic sum of Channels A & B signals

DC & ATTEN BAL

Screwdriver controls; when properly adjusted prevents depositioning of the pattern when VARIABLE and VOLTS/DIV controls are activated. (ATTEN BAL is concentric with POSITION control.)

Figure 2-1. Function of Controls and Connectors

2-5. INPUT SELECTOR SWITCH

Each channel is provided with an Input Selector switch which permits AC or DC coupling of the applied signal and a choice of NORMal or INVERTed polarity. When the Input Selector switch is set to GND, the input circuit of the Type 76-02A is grounded, and the applied signal is disconnected.

The Input Selector switch permits choice of retaining the dc level of the input signal or blocking the dc component of the input signal by inserting a capacitor in series with the input. If it is desired to display both the ac and dc components of a signal, set this switch to NORM DC. Thus, the position of the display at any instant is a function of the instantaneous signal voltage with respect to ground.

There are times when it is neither necessary nor desirable to display the dc component of the input waveform. A capacitor placed in series with the input connector will exclude the dc component while simultaneously permitting the ac component to be displayed. This is accomplished when the Input Selector switch is set to AC. The effects of the dc component is now excluded from the display.

When using the dual-trace features of the Type 76-02A, you may desire to invert the displayed waveform. In the NORM position of the Input Selector switch, the displayed waveform will have the same polarity as the applied signal. When the Input Selector switch is set to INVERT, the displayed waveform will be inverted. In other words, a positive-going pulse will be displayed as a negative-going pulse.

2-6. OBTAINING A DISPLAY

To use the Type 76-02A Amplifier to obtain a display, proceed as follows:

1. Signals to be observed are connected to the Type 76-02A Amplifier through the Channel A and/or Channel B connector via shielded cable or an Attenuator Probe.
2. Establish a common ground between the oscilloscope chassis and the signal source.
3. If it is desired to display a single trace with the Type 76-02A Amplifier, simply apply the signal to either Input connector and set the MODE switch to the corresponding position (A or B).
4. To display two signals simultaneously, connect a signal to each Input connector and set the MODE switch to ALT or CHOP. The chopped position is used when it is desired to reduce the "flickering" of the display when observing input signal data at slow speeds (below 1 millisec/div). External triggering of the Time Base is to be preferred in chopped position to prevent the sweep from triggering on the "chopping" signal.

In general, the CHOP position is used with lower sweep rates and the ALT position with higher sweep rates.

5. To display the algebraic sum of two signals, connect a signal to each Input connector and set the MODE switch to A + B.
6. To display the algebraic difference of two signals, apply a signal to each Input connector and set the MODE switch to A + B. For A − B presentation, set Channel A Input Selector switch to NORM and Channel B Input Selector switch to INVERT. For B − A presentation, set A switch to INVERT, and B switch to NORM.
7. Adjust the appropriate Time Base Plug-in controls to obtain a stable display of the pattern.
8. Set the VOLTS/DIV switch and POSITION control such that the size and position of the display is as desired on the screen.

2-7. ADDITIONAL HINTS

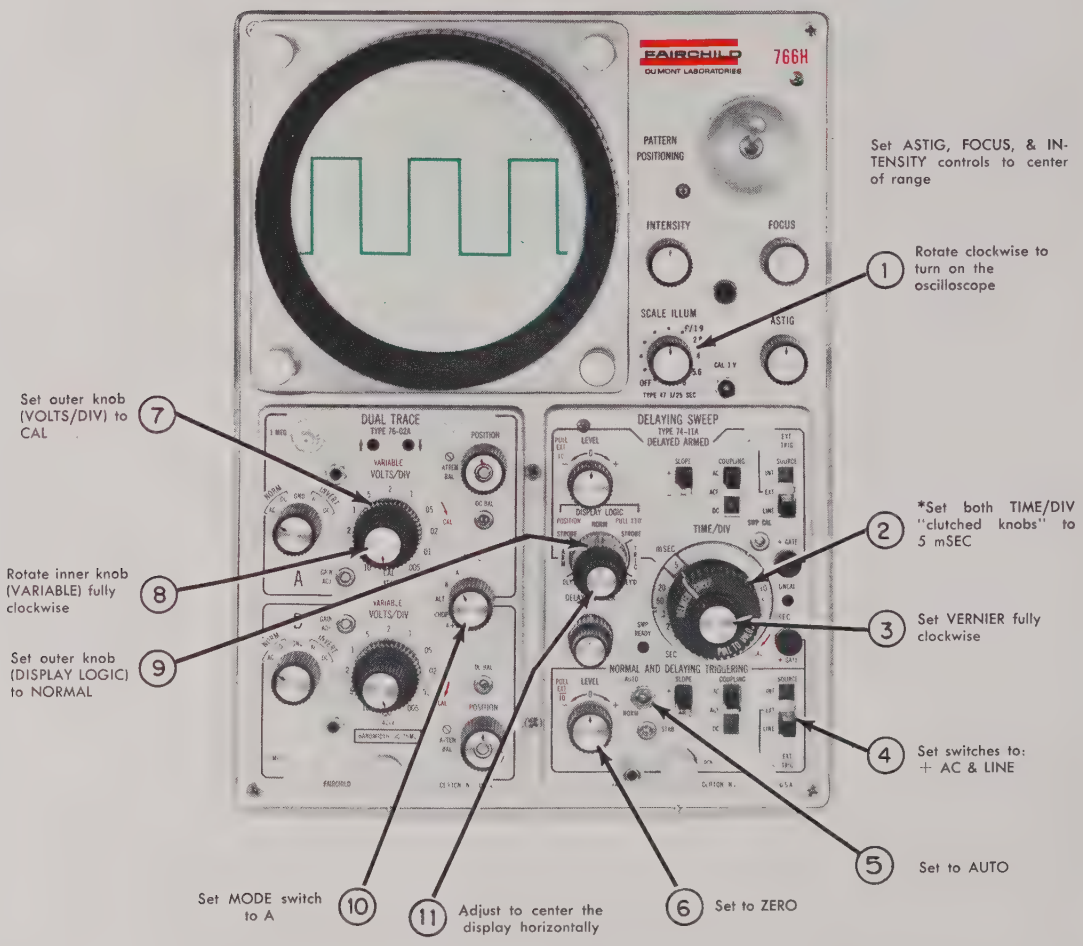
In addition to the information given in the paragraphs preceding, observe the following precautions when applying signals to the oscilloscope:

1. Avoid errors in readings due to stray coupling between circuits, particularly in the signal lead. As a rule, do not use long, unshielded leads for applying signals to the oscilloscope. This fact holds for the audio-frequency spectrum, except possibly when making measurements on low impedance circuits at very low frequencies. Coaxial or shielded input cables are recommended for most applications.
2. In broadband applications, it may be necessary to terminate a coaxial cable with a resistance equal to its characteristic impedance. This is done to prevent standing waves or ringing (high-frequency damped oscillations).
3. To avoid erroneous results, the operator should simulate the actual operating conditions of the equipment being tested. For example, the equipment should work into a load impedance equal to that which it will see in actual use.
4. Consider the effect of loading upon the signal source due to the input impedance of the oscilloscope. The input impedance can be represented by a resistance shunted by a capacitance. The effective value of this impedance is indicated in the Specifications in Section 1. However, the operator should be aware that even with a few feet of cable in the input circuit, the loading capacitance on the circuit under investigation might be greater than 100 pf.
5. There are cases when connecting the input of the oscilloscope to a signal source, the effect of loading the source is not negligible. To minimize this loading and therefore obtain a valid measurement, a probe may be used in the manner described in the paragraph entitled "Use of Probes."
6. Care must be exercised when applying a fast rise, high-frequency signal to the Input connector. It will be necessary to match and properly terminate the coaxial cable applying the signal to the oscilloscope.

NORMAL SWEEP DISPLAY OF CAL SIGNAL

To obtain the calibrator display using NORMAL sweep, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.



Readjust (POSITION) control on the Y Amplifier to center display vertically

Readjust INTENSITY, FOCUS & ASTIG controls for a sharp pattern

*The TIME/DIV "clutched knobs" are engaged when the notch on the plastic skirt is aligned with the white pointer on the clutched knob

Figure 2-2. Type 76-02A Calibrator Display

7. As the length of the cable is increased, the necessity for proper termination becomes very important. This termination is generally inserted at the oscilloscope end of the cable, although many signal sources may require an additional termination at the other end of the cable. The Type 4285 Termination is recommended for 50-ohm systems.

For rack-mounting systems, observe the following precautions if long shielded cables are used.

1. It may be desirable to ground long shielded leads only at one end to avoid circulation currents. Even microamperes of extraneous currents in the shield braid will cause unwanted distortions.
2. Use cable with insulation over the shield braid so that the cable does not accidentally touch ground.
3. Use off-ground insulated bulkhead feed-thru connectors where applicable.
4. Do not pass cables near strong ac magnetic fields.
5. Long shielded input cables may also include parasitic oscillations. It is suggested that a 100-ohm to 1000-ohm, ½-watt resistor be connected in series with the center conductor near or at the oscilloscope input terminals.
6. Use a resistance at least twice that required to just stop the parasitic oscillations. Too large a value may reduce the bandwidth of the system.

2-8. USE OF PROBES

An attenuator probe lessens both the capacitive and resistive loading caused by the oscilloscope to a minimum value. Simultaneously, while isolating the oscilloscope from the signal source, it reduces the effective sensitivity of the instrument. In other words, the displayed waveform will be reduced in amplitude by the attenuation factor of the probe. The attenuation introduced by the probe permits measurement of signal voltages in excess of those which may be accommodated by the instrument.

When using a probe to sample signals from a tuned, matched, or otherwise critical circuit, capacitive loading may cause erroneous readings. In these cases it may be necessary to remove capacity and resistance from the circuit under observation. When the observations and adjustments are completed, capacity and resistance precisely equal to that of the probe impedance should be added to the circuit, after the probe is removed from the circuit. This substitution will equalize loading and restore the operating characteristics of the circuit under observation to the same conditions when probe measurements were made.

When using the attenuator probe to make amplitude measurements, multiply the observed amplitude of the display by the attenuation factor marked on the probe.

The Accessory Probes listed in Section 1 of the Type 765 Series Instruction Manual have an attenuation factor of 10 to 1. The maximum voltage that may be applied to these probes is 600 volts dc plus peak ac. Voltages in excess of this value (either dc volts or peak ac volts) may cause damage to components inside of the probe housing.

IMPORTANT:

Before using the probe, always check its adjustment.

An adjustable capacitor in the probe compensates for variations in input capacitances from one unit to another. To insure accuracy in pulse and transient measurements, check the probe adjustment frequently. To check the probe, proceed as follows:

1. Connect the Probe to Input BNC connector on the Type 76-02A and apply the probe tip to the IV CAL pin jack on the Main Frame. Set Selector switch to DC.
2. Adjust the oscilloscope to display several cycles of the calibrator waveform.
3. Adjust the variable capacitor in the body of the probe for a flat-top trace on the screen.
4. To preserve the waveform of the signal being displayed, clip the probe ground lead to the chassis of the equipment being tested. Select a short clean ground point near the probe input connection.

2-9. DUAL-TRACE OPERATION

Using the Type 76-02A Dual-Trace Plug-in unit with the Main Frame, makes it possible to view two different time-shared vertical input signals displayed against one time base. The electronic switch will alternately accept either the Channel A or Channel B signal when the MODE switch is set to ALT. Each channel retains individual control of sensitivity, position, polarity, etc. Should the sweep rate be so low that the display has excessive flicker, the MODE switch may be set to CHOP position. The electronic switch will now chop the signals at approximately 60 Kc rate. Switching transients will automatically be blanked for a clean, undistorted display.

The dual-trace display applications include comparisons of the input and output of the amplifiers, multivibrators, shaping circuits, comparative phase and time delay measurements, etc.

Do not use internal triggering when in the chopped mode, since the random switching transients will cause poor synchronization of the sweep.

2-10. DUAL-TRACE TRIGGERING

a. Introduction

For simplicity of operation, dual-trace triggering may be categorized as follows:

1. External triggering using alternate or chopped modes of operation.

2. Internal triggering using the alternate mode.
3. Internal triggering using the chopped mode.

b. External TRIG Using CHOP or ALT Modes

For dual-trace operation, it is preferable to trigger the time base with an external signal which bears a fixed time relationship to the applied signal. One of the applied signals may normally be employed as the external triggering signal. When this technique is used, a stable display is more readily obtained, and the true time or phase relationship of the two signals is discernible.

In low-frequency applications, one of the applied signals may be used as the external triggering signal. In general, useful stable displays may be obtained by this technique without excessively loading the signal source. However, in high-frequency applications, such a method for deriving the triggering signal loads down the signal source resulting in an unsatisfactory display. Therefore, a non-loading method must be used for obtaining the external trigger. For example, if the Fairchild Type 781 Time-Mark Generator is the signal source, use the TRIGGER OUT pulse from this generator to externally trigger the oscilloscope.

c. Internal TRIG Using ALT Mode

Internal triggering of the time base may be used if the time or phase relationship between the two signals is not critical. In alternate mode of operation, the signal applied to the Type 76-02A internally triggers the Time Base Module, which in turn switches the channels at the completion of each sweep cycle during the retrace intervals.

Hence, it is important to set the Time Base TRIG LEVEL control to a point where the sweep can trigger on the signal applied to each channel. If one of the applied signals possesses a smaller amplitude than the other, then the TRIG LEVEL control must be set for reliable triggering on the smaller amplitude signal to insure the successful operation of the alternate mode switching cycle. Also, to avoid triggering on the change in dc positioning level between channels, set the Time Base Coupling switch to ACF or LF REJECT.

d. Internal TRIG Using CHOP Mode

For dual-trace chopped-mode operation, reliable internal triggering may be obtained when the repetition rate of the applied signals is coincident with the chopping rate. If this latter condition is not met, the Time Base Module will endeavor to trigger on the composite chopping-rate signal rather than on the applied signals. In this instance, a stable display may sometimes be obtained by carefully setting the Time Base TRIG LEVEL control to the point where best triggering with minimum jitter is noted. Also use ACF or LF REJECT COUPLING. Refer to any of the Time Base Plug-in Instruction Manuals for further information on triggering.

2-11. DUAL X-Y DISPLAYS

It is possible to display two different sets of X-Y parameters on the Type 765 Family of Oscilloscopes through the use of two Type 76-02A Plug-in Amplifiers. This technique is useful if it is desired to observe operating characteristics of two identical items, such as electron tubes, under different operating conditions. To display two sets of X-Y parameters simultaneously, proceed as follows:

1. Insert a Type 76-02A Plug-in into each cavity of the Type 765 Series Oscilloscopes.
2. Set the MODE switch of one plug-in unit to CHOP and the other one to ALT.
3. Apply one pair of signals to the Channel A Input connectors and the other pair of signals to the Channel B connectors.
4. Set the VOLTS/DIV switches and the POSITION controls for the desired display.

2-12. VOLTAGE MEASUREMENTS

NOTE

When making voltage measurements, make sure there is a common ground between the oscilloscope and the signal source.

a. General

The Type 765 Family of Oscilloscopes may be used to measure the voltage of the input signal by using the calibrated VOLTS/DIV setting and observing the height of the display on the screen in graticule divisions.

When making voltage measurements, the operator should try to set up the instrument for full scale vertical deflection to insure maximum accuracy. Also, it is important to remember that the width of the trace may be an appreciable part of the over-all measurement. This is particularly true when you are measuring signals of small amplitude or when stray signal pickup has broadened the trace. The operator should consistently make all measurements from one side of the trace. If the top side of the trace is used for one reading, it should be used for all succeeding readings.

b. How to Measure Peak-To-Peak Voltages Using the CRT Scale

The procedure employed for all voltage measurements is basically the same. The VARIABLE control

must be set to CAL. The specific examples that follow are intended to show the general procedure. These examples may be adapted to fit any particular application.

To measure the ac component of the signal on display, set the Input Selector switch to AC. In this position, only the ac components of the input signal are displayed on the screen. However, when the ac components of the input is of very low frequency (under 10 cps), set the Input Selector switch to DC to prevent errors.

To make measurements, proceed as follows:

1. Using the calibrated scale, measure the vertical deflection in graticule divisions from the positive peak to the negative peak of the waveform. See Figure 2-3.
2. Multiply the vertical dimension obtained in step 1 by the VOLTS/DIV switch setting to obtain the indicated voltage.
3. Multiply the indicated voltage obtained in step 2 by the attenuation factor of the probe, if one is used, to obtain the actual peak-to-peak voltage.

For example, suppose that you are using a 10:1 Attenuator Probe and the VOLTS/DIV switch is set to 0.1. Assume that the vertical distance between the peaks of the waveform measures 4 graticule divisions. Now, this graticule dimension of 4 is multipled by the VOLTS/DIV setting of 0.1 to give 0.4 volt. Next, multiply this result by 10, if a 10:1 Attenuator Probe is used. This gives 4 volts as the peak-to-peak voltage of the display waveform.

Note: Always make sure that the VARIABLE control is set to CAL when making measurements.

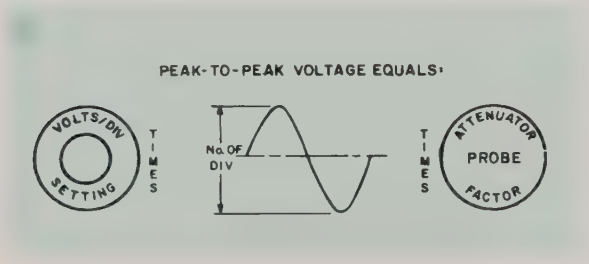


Figure 2-3. Peak-To-Peak Voltage Measurements

c. How to Measure Instantaneous Voltages with Respect to Ground (or some other Reference Potential) Using the CRT Scale

The technique used for measuring instantaneous voltages with respect to a reference point, is virtually the same as that described for peak-to-peak voltage measurements. The difference is that now a reference point must be established on the screen of the oscilloscope. Since voltage measurements with respect to ground are the most common, the procedure which follows, establishes ground as the reference point. The same general technique may be used for instantaneous measurements with respect to any other potential, just so long as that potential is employed to establish the reference point.

To make measurements, proceed as follows:

1. Set the Input Selector switch to DC.
2. Adjust the appropriate Time Base Plug-in controls to obtain a reference trace.
3. To establish the reference point, touch the probe tip to the ground terminal on the oscilloscope (or to the desired source potential, if a point other than ground is used). Vertically position the trace to a convenient point on the screen. This point should be chosen so that it lies on one of the major horizontal scale divisions. The chosen horizontal scale line, which is now coincident with the trace, is the reference line from which all voltage measurements are to be made.
4. Disconnect the probe tip from ground and connect it to the signal source without disturbing the POSITION control.
5. Adjust the oscilloscope controls for a suitable and stable display.
6. Using the calibrated scale, measure the number of graticule divisions from the desired point on the waveform to the pre-established reference line set up in step 3. See Figure 2-4.
7. Multiply the graticule dimension obtained in step 6 by the VOLTS/DIV switch setting to obtain the indicated voltage. Make sure that the VARIABLE control is set to CAL.
8. Multiply the indicated voltage obtained in step 7 by the attenuation factor of the probe used to obtain the actual instantaneous voltage.

For example, suppose that you are using a 10:1 Attenuator Probe and the VOLTS/DIV switch is set to 0.1. Assume that the vertical distance between the desired point on the waveform to the pre-established reference line is 4 graticule divisions. Now, multiply this vertical deflection of 4 divisions by the VOLTS/DIV setting of 0.1 to give 0.4 volt. Next, multiply this result by 10, the attenuation factor of the probe. This shows that the instantaneous voltage with respect to ground to be 4 volts. Since the voltage point is above the reference line, the indicated polarity is positive.

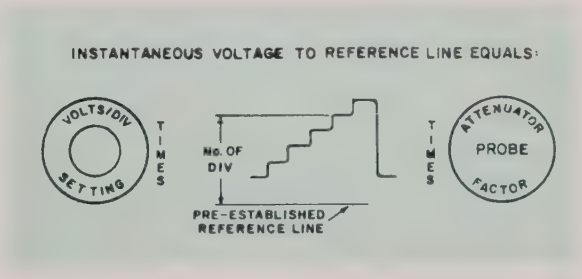
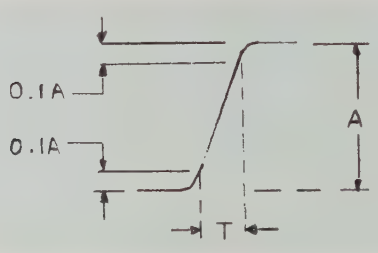


Figure 2-4. Instantaneous Voltage Measurement with respect to Ground (or some other Reference Potential)

2-13. MEASURING SHORT RISE TIMES

The rise time is defined as the time between 10% and 90% of the amplitude.



Connect the circuit under investigation with a 50-ohm cable RG-8A/U, terminated with a Type 7093 pad to the input of the oscilloscope. The rise time of the circuit is expressed in the form

$$T = \sqrt{T^2_{crt} - T^2_{ampl}}$$

in which T_{crt} is the measured rise time on the oscilloscope and T_{ampl} is the rise time of the Type 76-02A which is 15 nanoseconds.

Using a Type 4285A 50-ohm termination, the amplifier rise time is 15.5 nanoseconds due to the loading effect of the 40 pf input capacitance. The Type 7093, 50-ohm 5:1 pad is recommended for short rise time measurements. The display of the pulse should be within the quality square of 6 divisions to avoid saturation of the output tubes and related distortion of the pulse response.

SECTION 3
CIRCUIT DESCRIPTION

3-1. INTRODUCTION

To simplify circuit description of the Type 76-02A Dual Trace Amplifier, functional block diagrams are provided as follows:

Figure 3-1. Type 76-02A Input Circuit, Functional Block Diagram

Figure 3-2. Type 76-02A Channels 1 & 2, Functional Block Diagram

Figure 3-3. Type 76-02A Electronic Switching Circuits, Functional Block Diagram

Figure 3-4. Type 76-02A Y Deflection Amplifier, Functional Block Diagram

Refer to Figure 5-1 in the Maintenance and Recalibration Section for the over-all system block diagram.

The circuit description will be keyed to the above-mentioned illustrations. Emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of the manual be referred to in following the circuit description.

3-2. INPUT AMPLIFIER CIRCUIT DESCRIPTION

a. Input Channel (Figure 3-1)

The Type 76-02A Plug-in is a two-channel amplifier designed for use with the Type 765 Series Oscilloscopes. It consists of two identical input channels (Channel A and Channel B), an electronic switching system, and a common vertical deflection amplifier. The output of either or both input channels may be applied to the common vertical amplifier depending on the setting of the MODE selector switch.

Each input channel consists of an attenuator and a preamplifier. Since the input channels are identical, the circuit description will refer to Channel A only. Operation of Channel B will be the same as A except where otherwise noted.

The Input Selector switch permits choice of retaining the dc level of the input signal or blocking the dc component of the input signal by inserting a capacitor in series with the input. When this switch is set to the NORMal sector, the displayed waveform will have the same polarity as the applied signal. The displayed waveform will reverse polarity when the switch is set to the INVERT sector. If this switch is used when the MODE switch is set to A + B, the unit may be set up for A minus B or B minus A presentation. A GND position is provided on the Input Selector switch to facilitate the dc balancing of the input amplifier. The VOLTS/DIV switch permits the desired attenuation

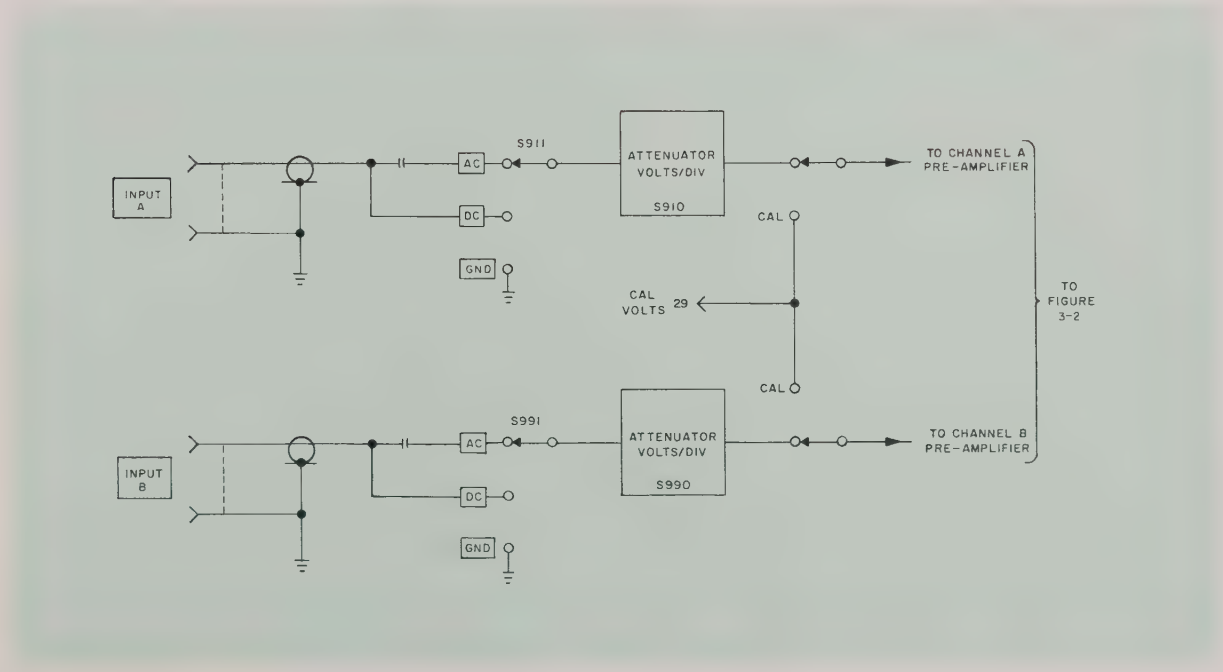


Figure 3-1. Type 76-02A Input Circuit, Functional Block Diagram

of the input signal in calibrated steps as indicated by the front-panel markings.

An internal calibrating voltage is applied to the vertical input dc amplifier when the VOLTS/DIV switch is set to CAL. This automatically disconnects the Y Input signal from the amplifier when the calibrator signal is applied. The GAIN ADJ front-panel screwdriver control is employed to normalize the gain between channels and between the Plug-in module and the Main Frame. When gains are normalized, the peak-to-peak value of the calibrator waveform will indicate 4 divisions of vertical deflection on the screen.

b. Pre-Amplifier (Figure 3-2)

The nuvistor amplifier V920 and V921, converts the single-ended input signal at the grid of V920 to a push-pull output signal at the collectors of Q9200 & Q9201.

Resistors R9207 and R9209 in series with the grids of these tubes, serve to suppress any parasitic high-frequency oscillations. Resistor R9206 is provided to limit grid current in the event that any excess voltage is applied to the input.

The VARIABLE control is connected between the cathode of V920 and V921 in the gain control stage. Any difference in the dc level between the two cathodes will cause the trace to shift vertically as the VARIABLE control is rotated. The DC BAL control nulls the dc voltage across the VARIABLE control, so that in the absence of an input signal, there will be no depositioning of the trace when the VARIABLE control is rotated throughout its range.

Since the emitter loads of Q9202 and Q9203 are tapped down on the three most sensitive ranges of the VOLTS/DIV switch, the attenuator requires balancing. The The ATTEN BAL control is provided to equalize the emitter voltage of Q9202 and Q9203. In this way, tapping down on the load between these emitters does not reflect as pattern positioning changes on the screen in the absence of input dc signal. Therefore, when the attenuator is balanced, there will be no depositioning of the trace.

The POSITION control is introduced across the emitters of amplifier Q9204 and Q9205 and allows vertical positioning of the trace. Also, these amplifiers are switched on or off by the electronic switching circuits so that the modes of operation as indicated by the front-panel MODE switch can be obtained.

3-3. ELECTRONIC SWITCH CIRCUIT DESCRIPTION (Figure 3-3)

a. Blanking Multivibrator

Selection of the input channel whose output is to be applied to the common vertical deflection amplifier, is accomplished by means of the Electronic Switching circuit.

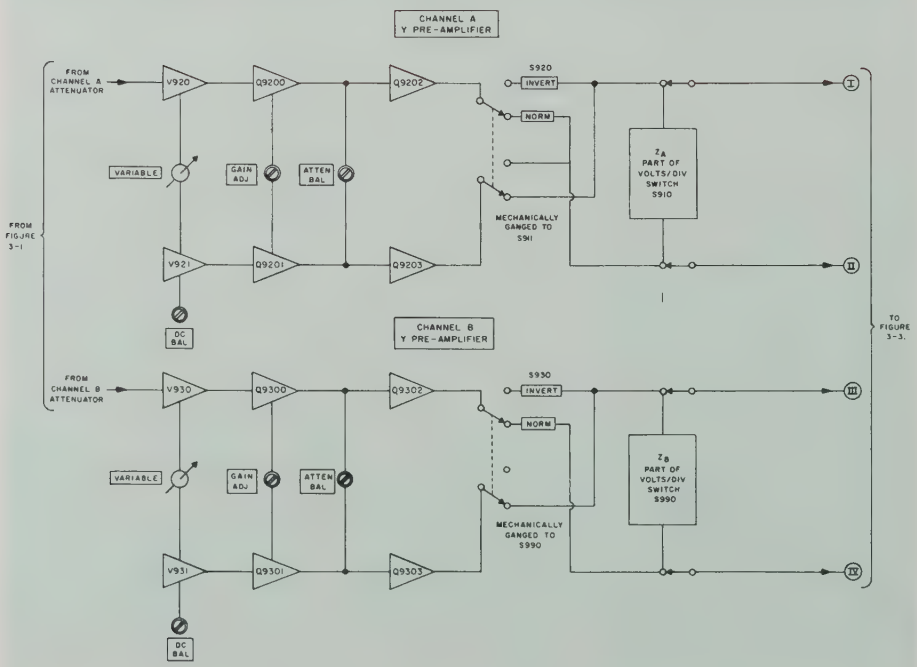


Figure 3-2. Type 76-02A Channels A and B, Functional Block Diagram

The timing of the electronic switch Q9600 and Q9601, is provided by the blanking multivibrator Q9701 and Q9702. The blanking multivibrator may be switched to either a monostable or a free-running condition by the MODE switch S960. When the MODE switch is set to A, B, A +B, or ALT, a negative bias is applied through resistor R9705 and diode CR9708 to the base of transistor Q9702. This action locks the blanking multivibrator in the monostable state with Q9702 turned off and Q9701 turned on.

When the MODE switch is set to CHOP, this bias voltage is removed, permitting free-running operation of this stage. This gating voltage is applied to the electronic switch which alternately functions to turn Channels A and B off and on at a 60-Kc rate, independent of the sweep rate. Each channel is *on* approximately 6 microseconds, and *off* for 9 microseconds including the blanking time.

External triggering of the Time Base is to be preferred in the chopped position to prevent triggering of the sweep on the *chopping* signal.

The timing of the blanking multivibrator is determined by the master trigger from the unblanking amplifier of the Time Base unit. This positive-going master trigger is coincident with the trailing edge of the sweep gate and is applied through the series coupling diode CR9704 to the base of Q9702, turning it on momentarily. Consequently, one narrow negative pulse is generated at the collector of Q9702 for each positive trigger input. However, in the free-running position only, the output of the blanking multivibrator is independent of the input triggering signal.

It is necessary to turn off the cathode-ray tube beam as the switching between channels occurs. This is accomplished by applying the negative pulse generated at the collector of Q9702 to the switch-transient blanking amplifier Q9703. The resulting +35-volt blanking pulse is applied to pin 4 of the interconnecting plug to the cathode of the CRT.

b. Electronic Switch

When the MODE switch is set to A + B, the B+ voltage for the electronic switch Q9600 and Q9601, is disconnected. This allows both pre-amplifier channels to work simultaneously, thus providing a computer type algebraic adder circuit for Channels A and B. Use of the INVERT switch (polarity inversion) may give A minus B or B minus A presentation.

Due to loading of one channel by the other, the bandwidth of the system is reduced slightly in this position.

In positions A or B of the MODE switch; a cut-off bias is applied to the appropriate side of the electronic switch, holding the inactive channel in a continual cut-off position. In other words, the electronic switch is locked, (Q9600 is continually on, and Q9601 is continually off, or vice versa) and will not respond to the triggering signals from the blanking multivibrator.

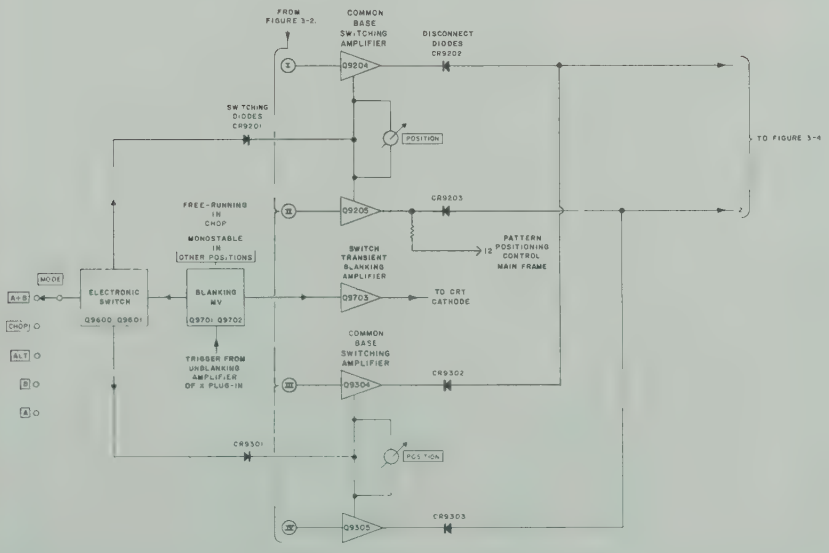


Figure 3-3. Type 76-02A Electronic Switching Circuit Functional Block Diagram

For example, when the MODE switch is set to B, a fixed bias is applied through R9605 to the base of Q9600, cutting it off; at the same time, Q9601 is fully conducting. The elevated voltage at the collector of Q9600 is applied to the anode of switching diode CR9201 causing it to conduct. The emitters of Q9204 and Q9205 are raised, thus plunging this stage into cutoff. Hence, Channel A pre-amplifier output is arrested at this point.

Switching diode CR9301, connected between the electronic switch and Channel B switching amplifier, is back-biased by the depressed voltage from Q9601. This permits the emitters of Q9304 and Q9305 to operate at their normal bias. Thus, only Channel B output progresses to the common vertical deflection amplifier.

When the MODE switch is set to A, just the opposite condition exists. Channel B stage, Q9304 and Q9305, is cutoff and Channel A stage, Q9204 and Q9205 conducts.

Diodes in the collector leads of each of the switching output stages of the pre-amplifier disconnect the collectors when the amplifier is turned off. This technique isolates the active adjacent channel collectors which would otherwise be in parallel with the inactive channel and cause capacitive loading. In this way, the maximum available bandwidth may be maintained.

In the ALT or CHOP positions of the MODE switch, no fixed bias is applied, thus permitting the electronic switch to be keyed at will by the blanking multivibrator. Thus, Q9600 and Q9601 become a bistable switching multivibrator.

When the MODE switch is set to ALT, the cathode-ray tube displays the signal in one channel for one sweep of the beam, and the signal in the other channel for the next sweep of the beam.

3-4. COMMON DEFLECTION AMPLIFIER (Figure 3-4)

The output from the channel switching amplifier is applied to the common emitter followers Q9400 to Q9403. A Type 7001 balanced distributed bifilar helical delay line is available as an accessory. The delay provided is sufficient to view base line and the leading edge of the signal triggering the time base, when the instrument is set up for internal triggering.

Proper delay line termination is provided by filters Z9401 and Z9402 which compensates for the input capacities of transistors Q9413 and Q9414 respectively.

Just before the delay line is encountered, a portion of the signal from the common emitter followers Q9402 and Q9403, is applied to the trigger pick-off amplifier. This latter circuit, Q9501 to Q9503, provides an internal trigger signal for firing the time base circuit as desired.

When using the dual trace feature of this Plug-in for internal triggering of the time base, always use ACF coupling to avoid triggering on the change in dc positioning level between channels. All signals having low-frequency components above 10 Kc should use external trigger coupling.

A network consisting of R9254, R9255, R9256, R9261, C9218 (sheet 2 of schematic), R9443 and R9444 (sheet 3 of schematic), provides a feedback circuit to preserve the input signal waveform as it progresses through the amplifier.

The output from the delay line (if one is used) or from the preceding stage, is applied to a series of transistorized amplifiers denoted as the drivers. These drivers are operated in parallel to provide the necessary power requirements for driving the vertical deflection plates of the CRT.

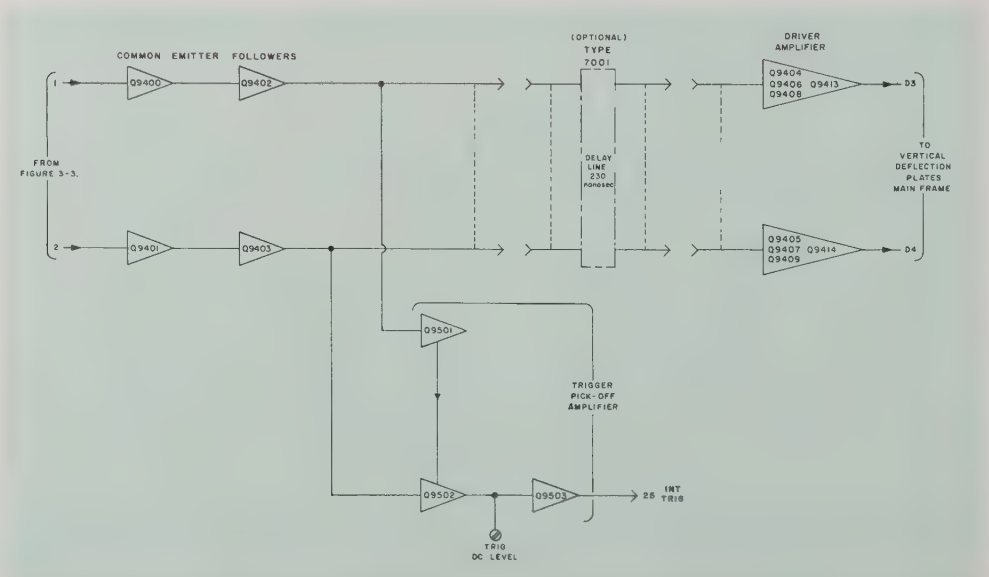


Figure 3-4. Type 76-02A Y Deflection Amplifier Functional Block Diagram

SECTION 4
PERFORMANCE ASSURANCE TEST

4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 5, paragraph 5-5, for list of test equipment required.

All tests are performed with a representative Type 765 Series Main Frame Oscilloscope and a Y Amplifier Plug-in. Both of the plug-in units must be normalized to the Main Frame before starting tests. This is accomplished by adjusting the front-panel screwdriver SWP CAL and GAIN CAL controls as described in the appropriate plug-in Instruction Manuals. Allow 30 to 60 minutes of warmup time before making any adjustments.

NOTE

If this Plug-in module is checked by a Receiving Inspection laboratory, the tests outlined below are recommended to certify performance. This instrument has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence, it is suggested that the certifying engineer try the recommended adjustments not only for recentering the controls, but also to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined in the paragraphs to follow, the instrument will not perform to specification, the assistance of the local Fairchild Field Engineering representative should be requested.

4-2. CHECKING SENSITIVITY OF CHANNELS A & B

1. Set VOLTS/DIV switch and VARIABLE control to CAL.
2. Adjust Time Base unit for a sweep rate of 10 msec/div and observe 6 cycles of calibrator waveform at 60-cycle line. (5 cycles for 50-cycle line.)
3. Adjust DC BAL control after unit has been operating 60 minutes or more.
4. Check range of GAIN ADJ screwdriver control, it should control the amplitude of the calibrator signal over a range from 3.2 to 4.2 divisions peak-to-peak.
5. Set GAIN ADJ control for precisely 4 divisions.

4-3. CHECKING PULSE RESPONSE OF CHANNELS A & B

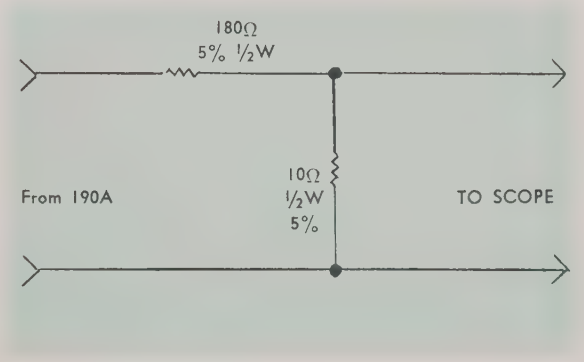
1. Connect a Fairchild Type 791 Square Wave Generator SOURCE IMPEDANCE switch set to 50 ohms, to the Type 76-02A through a 50-ohm cable, 10 db General Radio Attenuator and Type 4285 50-ohm termination. Use external cable delay and external trigger on the Type 74-03A when the Type 7001 Delay Line accessory is not used. Use internal trigger when the Type 7001 is included.
2. Set VARIABLE control to CAL. Unit must have warmed up 30 to 60 or more minutes before any checks are valid.
3. Observe a 20 mv peak positive rise on the Type 766H.

Note: The overshoot or preswing should be less than 0.25 division and ringing should be less than 2 line widths.

Fall time (10% to 90%) should be 15 nanoseconds or less. This includes the fall time of the Type 791 Square Wave Generator.

4-4. CHECKING BANDWIDTH OF CHANNELS A & B

1. Apply 50 Kc output of Tektronix Type 190A Signal Generator to Y Input connector through adapter. (See sketch.)



Adapter For Type 190A

2. Set VOLTS/DIV switch to 0.005 and adjust Time Base unit for RECUR sweep of 0.1 μsec/div.
3. Adjust test setup for precisely 4 divisions of vertical deflection.

4. Set Generator to high range and set frequency to 25 Mc. The sine wave amplitude at this frequency should have range of 2.4 to 3.2 divisions.

4-5. CHECKING MODE SWITCH

1. On A, check that A POSITION potentiometer controls the display.

2. On B, check that B POSITION potentiometer controls the display.

3. On ALT, check that A & B POSITION potentiometers control their respective displays. Vary the sweep rate from high to low sweep speeds.

4. On CHOP, check that A & B POSITION potentiometers control their respective displays.

5. On A + B, check that A & B POSITION potentiometers control the display.

SECTION 5
MAINTENANCE AND RECALIBRATION

5-1. INTRODUCTION (Figure 5-1)

This section of the Instruction Manual contains service information and procedures for internal adjustments. Refer to Figure 5-1 for an over-all functional block diagram of the Type 76-02A system.

5-2. REMOVAL AND REPLACEMENT OF PARTS

If it is necessary to order a replacement component from the factory, always give the Type Number and Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings, and the factory part number for all electrical components used in the instrument. This will help to expedite service.

Since your instrument left the factory, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from the factory, and it has been superseded by an improved component, the new part will be shipped in place of the part ordered.

It is the aim of the Fairchild organization to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any of our equipment to its specified performance. Your local Field representative maintains a limited number of spare parts. Also, the factory may be asked to airship replacement parts on a rush basis.

5-3. SERVICING HINTS

General maintenance and trouble shooting information is given in the Type 765 Series Oscilloscope Instruction Manual. In the following discussion, it is assumed that you have already read that information and have definitely isolated a trouble in this Plug-in Module.

In trouble-shooting a Plug-in unit, it becomes necessary to determine if the defect is in the plug-in or in the Main Frame of the oscilloscope. The quickest and easiest way of isolating the trouble is to substitute another plug-in unit and determine if the same trouble persists. If the trouble continues after substitution, it can be safely assumed that the defect is in the Main Frame.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble shooting this unit, refer to the system block diagram in this Section and also to the schematics.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush. However, to insure the reliability of measurements, we suggest that you recalibrate the Plug-in after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be fully checked and adjusted after the repair of replacement of any component in the unit. The complete adjustment procedure for this unit is given in this Section of the Instruction Manual.

In the event of improper performance of the Plug-in unit, the following suggestions are recommmended:

1. The Type 4294 Extension Cable for remote operation of the plug-in from the oscilloscope is available as an accessory. This plug-in extender will be helpful for routine maintenance and recalibration. Do not use this extension for HF alignments; instead, remove the Main Frame side cover.

2. A Type 766 Test Oscilloscope is recommended for localizing troubles, especially when servicing a Type 76-02A inserted in a Type 767 Oscilloscope. To check waveforms, use a high-impedance probe while trouble shooting.

3. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks when soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended.

4. When using accessory probes or adapters, be sure the trouble is not originating in the accessory before suspecting the instrument itself.

5. Once the defective stage has been localized, the component or components causing the trouble can be located by tube and component substitution or by voltage measurement. Key voltage measurements are shown on the over-all schematics at the rear of this manual.

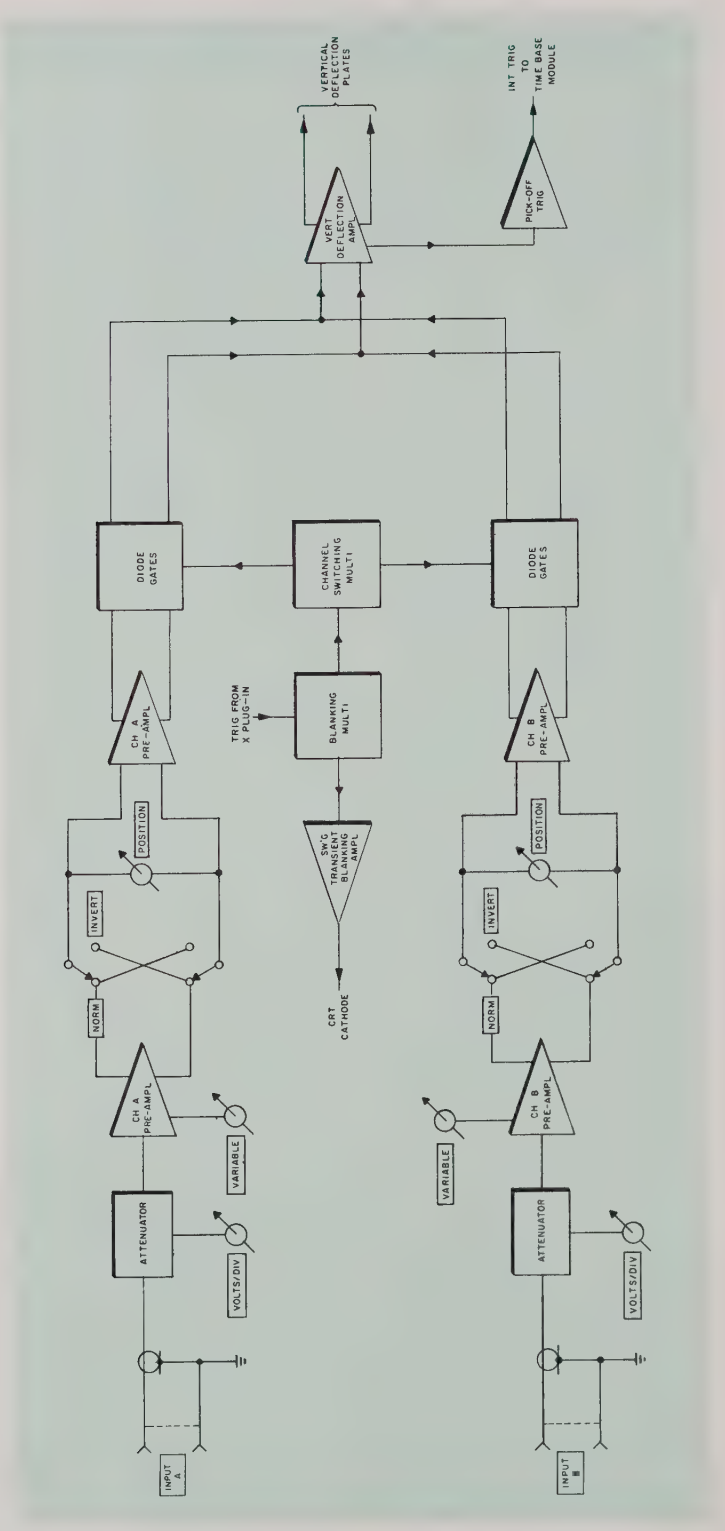


Figure 5-1. Type 76-02A Over-All System Block Diagram

6. Electron tubes, semiconductors, and service adjustments are identified on photographs located in this Section of the manual.

Note: Be sure and replace the beryllium oxide insulating washers (they serve as heat sinks) on the transistors that require them. Always grease these heat sinks with Dow Corning silicon grease for optimum heat transfer.

5-4. GAINING ACCESS TO CHASSIS

Since the Plug-in is not contained in its own dust cover, most of the components are readily accessible when the plug-in is removed from the Main Frame. To gain access to the chassis, simply unscrew the knurled thumbscrew at center bottom of unit and pull it free of the Main Frame.

WARNING

WHEN THE PANELS OR PLUG-INS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

Note: Always use insulated tools while working or making adjustments on the unit when power is on. The transistors in this instrument may be damaged if over-voltaged by accidental grounding of one or more elements. Exercise caution and turn off power when making repairs.

5-5. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. Introduction

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory. All adjustments should be made at mid-line voltage, 115V/230V ±2%.

To set up the Amplifier Plug-in unit for calibration, insert the Amplifier Plug-in and the Time Base Plug-in into the Main Frame. The Time Base Plug-in module and Main Frame must be fully tested and certified units.

b. Test Equipment Required (Equivalent may be substituted)

Equipment	Description
Oscilloscope	Fully certified and tested Type 766 Main Frame
X Plug-In	Type 74-03A
Volt-ohmmeter	Simpson Model 260; 20K ohms/volt sensitivity
Square Wave Generator	Fairchild Type 791
Sine Wave Generator	Tektronix Type 190A Constant Amplitude Sine Wave Generator and Adapter
5:1 Termination Pad	Fairchild Type 7093
Capacitance Standardizer	Fairchild Type 7012
Extension Cable for Remote Operation of Plug-in	Fairchild Type 4294
Alignment Tools	Fairchild Type 7013 Tool Kit
Pads	GR 6 db and GR 20 db

Turn on the power and allow 30 minutes of warm-up time.

5-6. DC BAL ADJUSTMENT R9200 & R9202 (R9300 & R9302)

NOTE

Reference symbols in parenthesis refer to Channel B.

If the dc balance of the Type 76-02A Amplifier is not properly adjusted, the reference trace on the screen will be depositioned when the VARIABLE control is rotated. To properly adjust, proceed as follows:

1. Set MODE switch to A and Input Selector switch to GND.
2. Set VOLTS/DIV switch to 0.005 and VARIABLE control fully counterclockwise.
3. Set front-panel DC BAL control R9202 to center of range and position trace to center of screen.
4. Adjust Coarse DC BAL potentiometer R9200 for no depositioning of trace when adjusting VARIABLE control back and forth.
5. Trim up with front-panel DC BAL control.
6. When the adjustment is complete, check that front-panel DC BAL control is set to its electrical center by setting VARIABLE control to minimum and positioning trace to center of screen.
7. Turn front-panel DC BAL control to one end, then to the other end. The deflection from center of screen shall be the same within 20% at the opposite ends of the potentiometer.
8. Set MODE switch to B and repeat steps 1 through 7 for Channel B.

5-7. GAIN ADJ R9212 (R9312)

Whenever the Type 76-02A Amplifier is removed from the Main Frame and inserted in another, the front-panel screwdriver GAIN ADJ control must be reset. To properly normalize the gain between channels or between the Plug-in unit and the Main Frame, proceed as follows:

1. Set both Channels A and B VOLTS/DIV switches to CAL and turn both VARIABLE controls fully clockwise to CAL.
2. Set MODE switch to CH A.
3. Adjust the sweep controls for a stable display.
4. Set Channel A front-panel screwdriver GAIN ADJ control for precisely 4 divisions of deflection.
5. Set MODE switch to ALT and adjust sweep rate for 2 msec/div.
6. Position the traces one on top of the other.
7. Adjust Channel A GAIN ADJ until only one trace may be observed (traces are superimposed).

5-8. TRIG DC LEVEL R9503

1. With no signal input, adjust the oscilloscope to obtain a trace centered on the screen.
2. Connect a voltmeter between pin 25 of P9001 and ground.
3. Adjust the TRIG DC LEVEL potentiometer R9503 for an indicated reading of zero volts.
4. Check that the beam position indicators operate properly.

5-9. HIGH-FREQUENCY ADJUSTMENTS C9209, C9211, C9406 & C9415 (C9309 & C9311)

1. Apply the output from a Fairchild Type 791 Square Wave Generator through a 50-ohm pad, then through a General Radio 10 or 20-db pad as required, and finally through a 50-ohm cable to Y Input terminated in 50 ohms.
2. Set Input Selector switch to NORM AC, VOLTS/DIV switch to 0.05, VARIABLE control to CAL, and MODE switch to A.
3. Set frequency range of Square Wave Generator to 500 Kc and adjust its output to give 4 divisions of vertical deflection.
4. Adjust the four trimmer capacitors C9209, C9211, C9406 and C9415 for the best flat-top square wave; ignore the bottom portion of this waveform.
5. Check the response in the 0.02, 0.01 and 0.005 VOLTS/DIV ranges.
6. Repeat steps 1 through 5 for Channel B.

Note: Do not reset trimmers C9406 and C9415 unless it is necessary. If these trimmers do have to be readjusted, work back and forth between Channels A and B until the best compromise is obtained. This completes the adjustments unless the Type 7001 Delay Line has been installed. If this be the case, proceed to step 7.

7. When the aforementioned adjustments have been made, a small step or notch of about 0.4 microsecond from the start of the trace may be noticed. This step is due to misalignment of the Type 7001 Delay Line termination. To minimize this notch, proceed as follows:
   a. Interchange the position of the X and Y Plug-in units. When these units are interchanged, the DELAY LINE TERM ADJ potentiometer R3 will now be accessible.
   b. Adjust this potentiometer R3 to minimize the notch at 0.4 microsecond from the start of the trace.
   c. Restore the plug-ins to their normal positions and slightly retouch the 4 trimmers of the preceding paragraph.
   d. The permissible overshoot should be less than 0.3 division out of 5 divisions. The termination bump should be less than 2 line widths.

5-10. INPUT CAPACITANCE STANDARDIZATION AND ATTENUATOR ADJUSTMENT (Figures 5-2 and 5-3)

The attenuators are factory aligned and should not be touched unless there is positive indication that they require adjustment. To make these adjustments, the front panel must be removed to gain access to the trimmer capacity. If adjustment is necessary, follow the steps as outlined making reference to Table 5-1. Reference symbols in ( ) pertain to Channel B.

The input capacitance standardization and attenuator adjustments are interdependent, therefore both tests must be performed in the same procedure. The need for readjustment is normally indicated by distortion of fast-rising waveforms on one or more of the most sensitive ranges of this plug-in unit.

Standardization of the input capacitance of this Y Plug-in unit requires the use of a 40-picofarad Capacitance Standardizer. To properly adjust the input capacitance and the attenuators of this plug-in unit, proceed as follows:

1. Interchange the X and Y Plug-ins. This procedure is required to gain access to the trimmers.
2. Adjust the trimmer of the Type 7012 Capacitance Standardizer to give 40 pf with a capacitance meter. If this meter is not available, set C9201 (C9301) to mid-range and adjust the trimmer of the Type 7012 instead of C9201 (C9301) when doing step 7.
3. Connect the Type 7012 directly to Channel A Input BNC connector on the Type 76-02A Plug-in.
4. Set the VOLTS/DIV switch to 0.05 and the Input Selector switch to NORM DC.
5. Apply the output from a Fairchild Type 791 Square Wave Generator through an RG-8A/U 50-ohm cable terminated in 50 ohms, through the 40-picofarad Capacitance Standardizer to the Input connector on the Type 76-02A. See Figure 5-2.

6. Set the Square Wave Generator to a 5 Kc and adjust the Time Base controls for a display of several cycles.

Note: Always center the square wave display on the cathode-ray tube screen. (Screen and square wave centers should agree within ±1 division or less.)

7. Adjust input trimmer C9201 (C9301) for flat-topped square waves (±0.2 div). Note comment in step 1 of this paragraph. See Figure 5-3.

8. Disconnect the 40-picofarad Capacitance Standardizer from the setup and connect the Type 7093 5:1 attenuator pad to the input BNC connector on the Type 76-02A.

9. Set Square Wave Generator to obtain 4 divisions of deflection and adjust the trimmer indicated in Table 5-1 for flat-topped response.

10. When adjustments are completed, restore the Plug-ins to their normal positions.

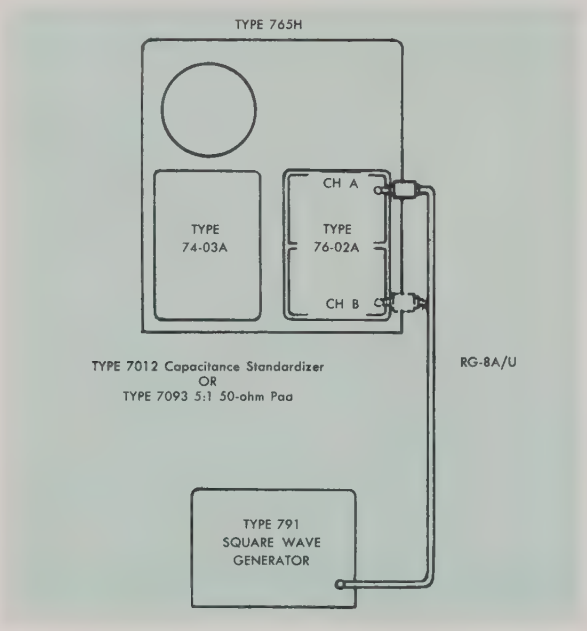


Figure 5-2. Test Setup for Adjusting Input Capacitance

TABLE 5-1

ATTENUATOR COMPENSATION TRIMMERS

VOLTS/DIV Setting	Adjust Trimmers for Flat Top
0.1	C9102 (C9902)
0.2	C9104 (C9904)
0.5	C9106 (C9906)
5.0	C9108 (C9908)
1.0	C9105 (C9905)
10	C9107 (C9907)

Disconnect the 50-ohm termination and reconnect the Capacitance Standardizer in the circuit. Continue the adjustments given below.

VOLTS/DIV Setting	Adjust Trimmers for Flat Top
0.1	C9101 (C9901)
0.2	C9103 (C9903)

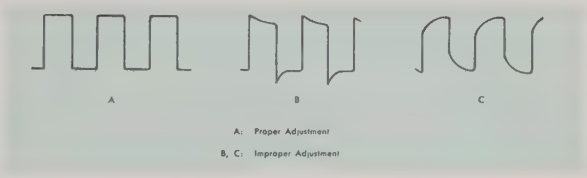


Figure 5-3. Standardizing the Input Capacitance

5-11. SET ATTENUATOR BALANCE R9234R (R9334R)

1. Vary VOLTS/DIV switch from 0.005 to 0.01.

2. Adjust ATTEN BAL potentiometer R9234R until there is no depositioning of the trace when switching the VOLTS/DIV switch back and forth.

3. Check the 20 and 50 millivolt ranges; readjust if necessary.

4. Repeat steps 1, 2, and 3 for Channel B.

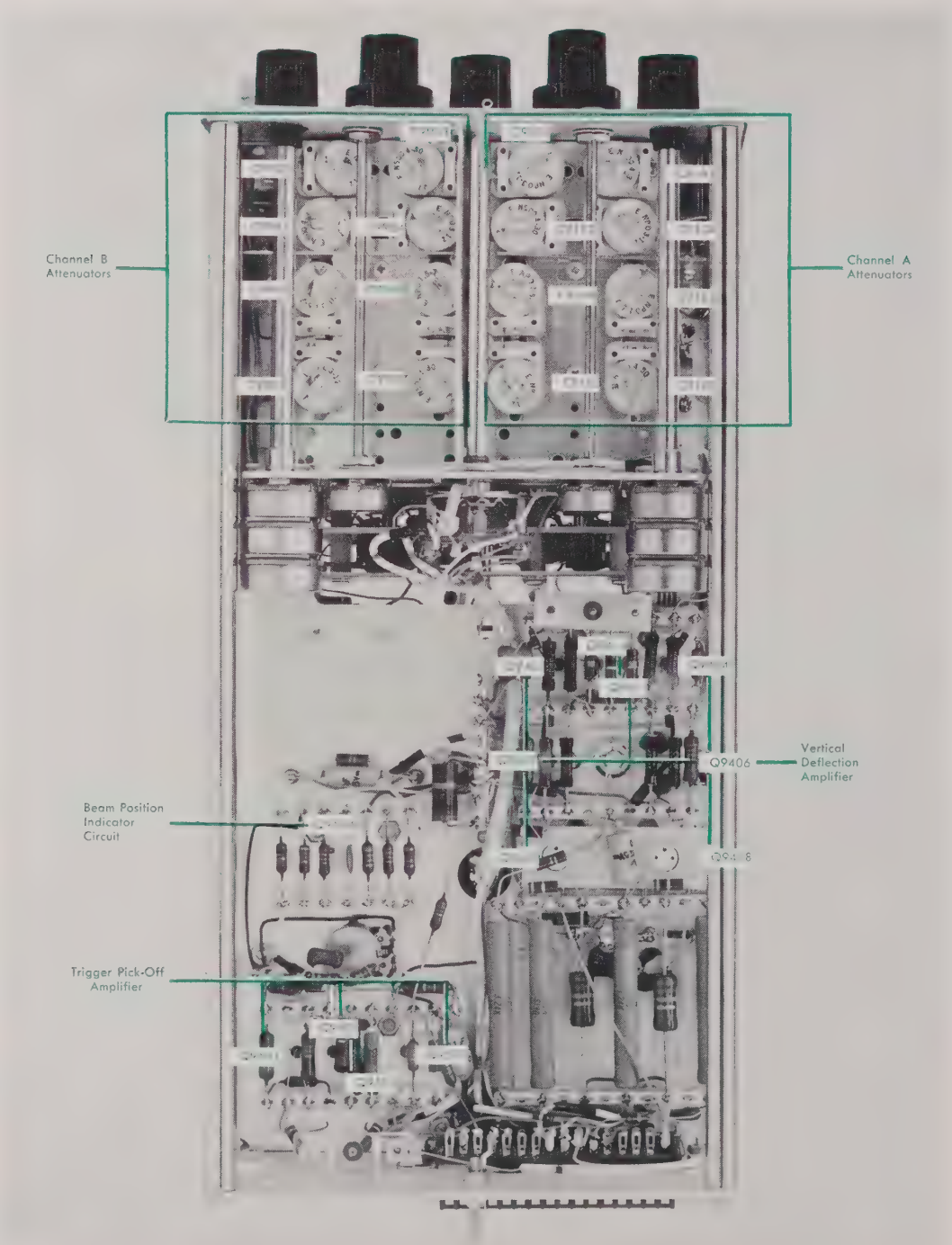


Figure 5-4. Right Side View Showing Transistors and Attenuator Trimmers

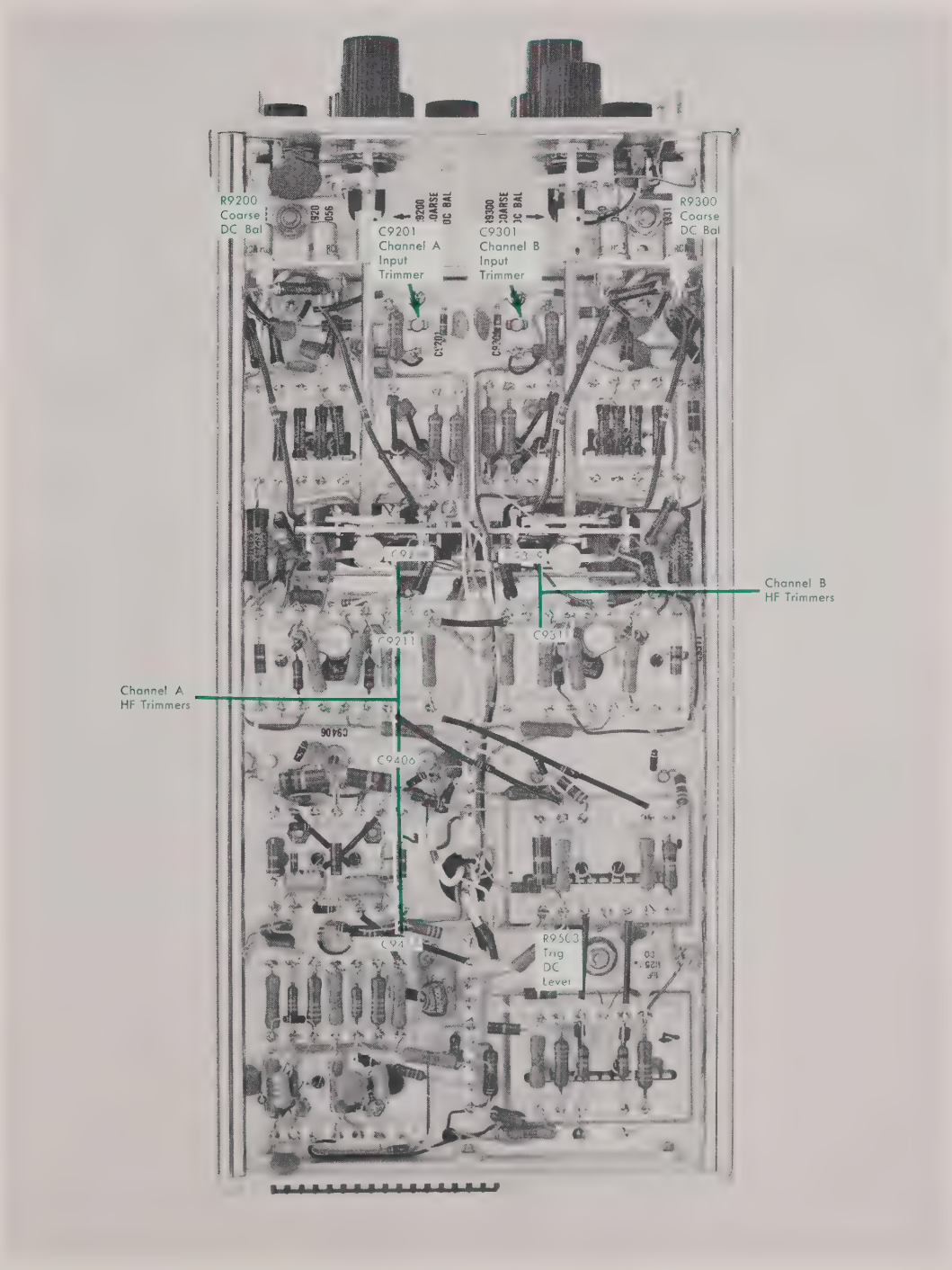


Figure 5-5a. Left Side View Showing Pots and Trimmer Adjustments

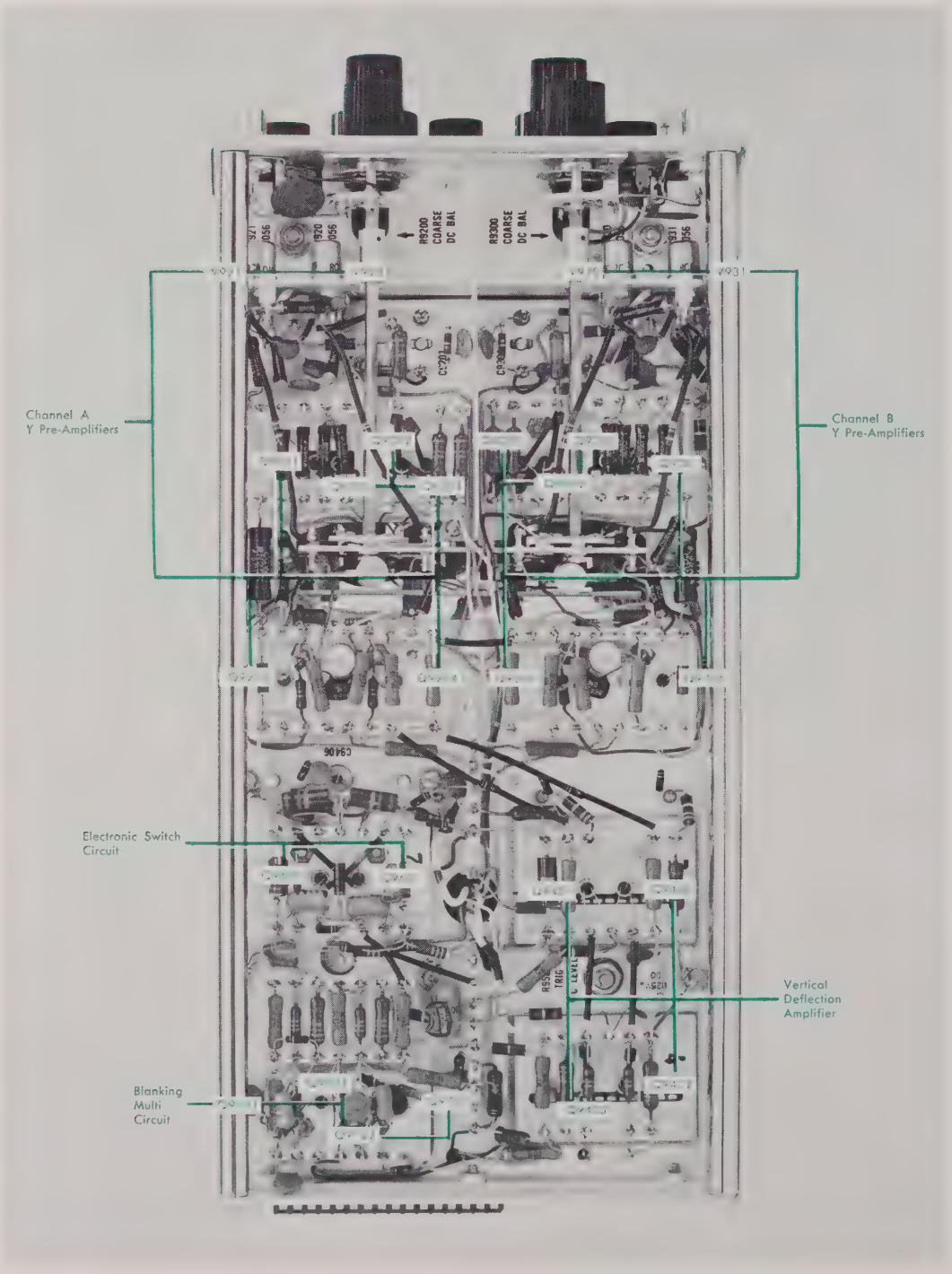


Figure 5-5b. Left Side View Showing Transistors and Nuvistors

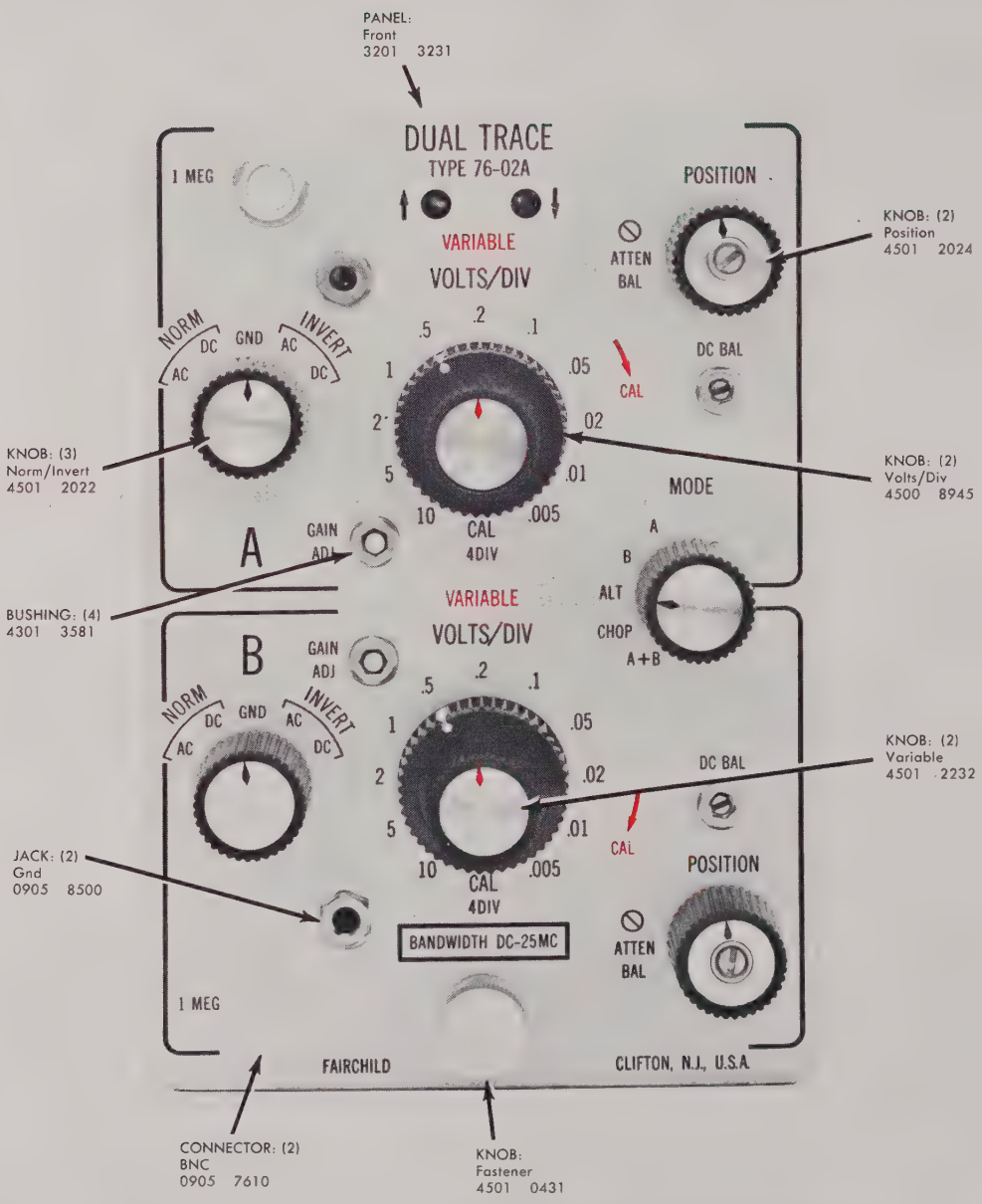


Figure 6-1. Front Panel Replaceable Parts

SECTION 6A
PARTS LISTS AND SCHEMATICS

TYPE 76-02A DUAL TRACE PLUG-IN

CAPACITORS

Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.

2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C9101	0300 3040	variable, 3-12 pf	ERC	TS2A-3
C9102 & C9103	0326 8650	variable, 4-30 pf	ERC	TS2A
C9104	0300 3040	variable, 3-12 pf	ERC	TS2A-3
C9105	0326 8650	variable, 4-30 pf	ERC	TS2A
C9106	0300 7790	variable, 1.5-7 pf	ERC	NPO-TS2A
C9107	0326 8650	variable, 4-30 pf	ERC	TS2A
C9108	0300 7790	variable, 1.5-7 pf	ERC	NPO-TS2A
C9109	0315 4110	56 pf, ±5%	EIA	
C9111	0316 0270	22 pf, ±5%	EIA	
C9112	0316 0530	30 pf, ±5%	ERC	
C9113	0326 8700	mica, 250 pf, ±10%	ERC	625-003
C9114	0317 5170	mica, 39 pf, ±5%	EMC	DM15
C9115	0326 4660	0.02 μf, GMV	ERC	
C9116	0317 5170	mica, 39 pf, ±5%	EMC	DM15
C9117	0317 3840	330 pf, ±10%	EIA	
C9200	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C9201 & C9202	0319 1281	variable, 0.7-3 pf	ABD	
C9203	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM
C9205	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C9206	0315 2190	68 pf, ±10%	ERC	NPO811-680
C9207	0315 4020	5.1 pf, ±0.5 pf	EIA	
C9208	0314 2690	91 pf, ±5%	ERC	GPI-331
C9209	0326 9480	variable, 9-35 pf, 100V	ERC	Style 538
C9211	0326 9480	variable, 9-35 pf, 100V	ERC	Style 538
C9212	0317 5220	mica, 56 pf, ±5%	EMC	DM-15
C9213	0326 7860	plastic, 0.1 μf, ±10%, 125V	AMX	C296AA
C9214	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM
C9215	0313 3810	composition, 0.68 pf, ±10%	STC	GA
C9217	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C9218	0326 7840	plastic, 0.047 μf, ±10%, 125V	AMX	C296AA
C9219	0315 2190	68 pf, ±10%	ERC	NPO 811-680
C9221	0316 7220	5.6 pf, ±0.25 pf (Delay Line Option)	ERC	NPO-331
C9300	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C9301 & C9302	0319 1281	variable, 0.7-3 pf	ABD	
C9303	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM
C9305	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C9306	0315 2190	68 pf, ±10%	ERC	NPO 811-680
C9307	0315 4020	5.1 pf, ±0.5 pf	EIA	
C9308	0314 2690	91 pf, ±5%	ERC	GPI-331
C9309	0326 9480	variable, 9-35 pf, 100V	ERC	538
C9311	0326 9480	variable, 9-35 pf, 100V	ERC	538
C9312	0317 5220	mica, 56 pf, ±5%	EMC	DM15
C9314	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM103
C9315	0313 3810	composition, 0.68 pf, ±10%	STC	GA
C9317	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C9319	0315 2190	68 pf, ±10%	ERC	NPO-811-680
C9321	0316 7220	5.6 pf, ±0.25 pf (Delay Line Option)	ERC	NPO-331
C9401 & C9402	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM103
C9403	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM203
C9404	0316 7370	15 pf	ERC	NPO-331
C9405	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM103
C9406	0326 9480	variable, 9-35 pf, 100V	ERC	538
C9407	0316 7280	10 pf, ±0.25 pf	ERC	NPO-331
C9408	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM203
C9409	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM103
C9410	0316 7280	10 pf, ±0.25 pf	ERC	NPO-331
C9411 & C9412	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM203
C9413	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM103
C9414	0316 7950	200 pf, ±20%	ERC	GP2K
C9415	0326 9480	variable, 9-35 pf, 100V	ERC	538
C9416	0326 7860	plastic, 0.1 μf, ±10%, 125V	AMX	C296AA
C9417	0316 7010	39 pf, ±5%	ERC	NPO-338
C9418	0326 4520	1000 pf, GMV	ERC	
C9419	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C9501	0316 7410	22 pf, ±5%	ERC	NPO-331
C9502	0316 7280	10 pf, ±0.25 pf	ERC	NPO-331
C9503 & C9504	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM
C9505 & C9506	0310 1270	1000 pf, +100 —0%, 1000V	RMC	B
C9507	0319 1060	0.01 μf, +60 —40%, 150V	CRL	DDM103
C9601	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM203
C9602	0315 1530	33 pf, ±10%	ERC	NPO-338
C9603 & C9604	0316 7050	51 pf, ±5%	ERC	NPO-338
C9605	0315 1530	33 pf, ±10%	ERC	NPO-338
C9606	0316 9440	470 pf, ±10%, 1000V	RMC	JL
C9607	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM
C9701	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM 203
C9702	0317 4250	820 pf, ±20%, 600V	CRL	No. D6-821
C9703	0316 6560	220 pf, ±10%	ERC	GP2-331
C9704	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM203
C9705	0326 7860	plastic, 0.1 μf, ±10%, 125V	AMX	C296AA
C9706	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM203
C9707	0317 5350	mica, 200 pf, ±5%	EMC	DM15
C9708	0319 1050	0.02 μf, +60 —40%, 150V	CRL	DDM203
C9709	0316 7280	10 pf, ±0.25 pf	ERC	NPO-331
C9711	0319 1060	0.01 μf, +60 —40% 150V	CRL	DDM103
C9801 to C9804	0310 1270	1000 pf, +100 —0%, 1000V	RMC	B
C9805	0326 7860	plastic, 0.1 μf, ±10%, 125V	AMX	C296AA
C9901	0300 3040	variable, 3-12 pf	ERC	TS2A-3
C9902 & C9903	0326 8650	variable, 4-30 pf	ERC	TS2A
C9904	0300 3040	variable, 3-12 pf	ERC	TS2A-3
C9905	0326 8650	variable, 4-30 pf	ERC	TS2A
C9906	0300 7790	variable, 1.5-7 pf	ERC	NPO-TS2A
C9907	0326 8650	variable, 4-30 pf	ERC	TS2A
C9908	0300 7790	variable, 1.5-7 pf	ERC	NPO-TS2A
C9909	0315 4110	56 pf, ±5%	EIA	
C9911	0316 0270	22 pf, ±5%	EIA	
C9912	0316 0350	30 pf, ±5%	ERC	
C9913	0326 8700	mica, 250 pf, ±10%	ERC	652-003
C9914	0317 5170	mica, 39 pf, ±5%	EMC	DM15
C9915	0326 4660	0.02 μf, GMV	ERC	
C9916	0317 5170	mica, 39 pf, ±5%	EMC	DM15
C9917	0317 3840	330 pf, ±10%	EIA	

DELAY LINE

Symbol	Part Number	Description	Recommended Vendor Code	Type
.....	*8901 6791	Type 7001	ABD	

* Depending on Sales order.

Symbol	Part Number	Description	Recommended Vendor Code	Type
SEMICONDUCTORS				
CR9200 to CR9203	2600 6910	diode, FD841	FCI	
CR9300 to CR9303	2600 6910	diode, FD841	FCI	
CR9601 to CR9605	2600 6910	diode, FD841	FCI	
CR9701 & CR9702	2600 6910	diode, FD841	FCI	
CR9704	2600 6910	diode, FD841	FCI	
CR9707 & CR9708	2600 6910	diode, FD841	FCI	
LAMPS				
DS9501 & DS9502	1201 2350	neon, 0.5 milliampere, 52-59 volts dc	SIG	T2 27 1R100
HYBRID COILS				
HY9202 to HY9205	2110 1560	Bead, ferrite	FER	56-590-65/3B
HY9302 to HY9305	2110 1560	Bead, ferrite	FER	56-590-65/3B
HY9400 to HY9407	2110 1560	Bead, ferrite	FER	56-590-65/3B
HY9501 & HY9502	2110 1560	Bead, ferrite	FER	56-590-65/3B
ELECTRICAL CONNECTORS				
J9101	0905 7610	receptacle, rf, female, 1 contact, BNC, UG-625A/U	DAG	
J9103	0905 8500	jack, assembly	AMA	Part #403
J9901	0905 7610	receptacle, rf, female, 1 contact, BNC, UG-625A/U	DAG	
J9903	0905 8500	jack, assembly	AMA	Part #403
P9001	0905 7340	plug, male, 32 contacts	APH	26-159-32
TRANSISTORS				
Q9200	2600 7700	DU #12A	FCI	
& Q9201	2600 7680	alternate 2N709		
Q9202 to	2600 2771	DU #2N	ABD	
Q9205	2600 7050	alternate 2N915		
Q9300	2600 7700	DU #12A	FCI	
& Q9301	2600 7680	alternate 2N709		
Q9302 to	2600 2771	DU #2N	ABD	
Q9305	2600 7050	alternate 2N915		
Q9400	2600 7060	DU #2	FCI	
& Q9401	2600 7050	alternate 2N915		
Q9402	2600 7020	DU #1A	FCI	
& Q9403	2600 7000	alternate 2N914		
Q9404	2600 7060	DU #2	FCI	
& Q9405	2600 7050	alternate 2N915		
Q9406	2600 7020	DU #1A	FCI	
& Q9407	2600 7000	alternate 2N914		
Q9408	2600 8550	DU #31S	FCI	
& Q9409	2600 2791	alternate 2N2218 (Selected)		
Q9413	2600 7070	DU #2A	FCI	
& Q9414	2600 7050	alternate 2N915		
Q9501 to	2600 7070	DU #2A	FCI	
Q9503	2600 7050	alternate 2N915		
Q9504	2600 7370	8A/2N699B	FCI	
Q9505	2600 7070	DU #2A	FCI	
	2600 7050	alternate 2N915		
Q9600	2600 7020	DU #1A	FCI	
& Q9601	2600 7000	alternate 2N914		
Q9701	2600 7020	DU #1A	FCI	
& Q9702	2600 7000	alternate 2N914		
Q9703	2600 7160	DU #4	FCI	
	2600 7150	alternate 2N1132		
Q9704	2600 7070	DU #2A	FCI	
	2600 7050	alternate 2N915		

Symbol	Part Number	Description	Recommended Vendor Code	Type
RESISTORS				
Note: All resistors are fixed, film, ±5%, ½W and values in ohms unless otherwise specified. K = thousand, M = million.				
R9101	0229 4890	500K, ±1%	TEX	CD1/2PR
R9102	0229 4900	750K, ±1%	TEX	CD1/2PR
R9103	0229 4910	900K, ±1%	TEX	CD1/2PR
R9104	0229 9010	990K, ±1%	TEX	CD1/2PR
R9105	0235 0190	52.3, ±1%, ¼W	TEX	CD1/4PR
R9106	0229 4700	1M, ±1%	TEX	CD1/2PR
R9107	0229 9040	333K, ±1%	TEX	CD1/2PR
R9108	0229 9050	111K, ±1%	TEX	CD1/2PR
R9109	0229 9080	10.1K, ±1%	TEX	CD1/2PR
R9111	0235 0140	105, ±1%, ¼W	TEX	CD1/4R
R9112	0235 0180	42.2, ±1%, ¼W	TEX	CD1/4R
R9113	0235 0190	52.3, ±1%, ¼W	TEX	CD1/4R
R9114	0235 0140	105, ±1%, ¼W	TEX	CD1/4R
R9115	0203 0000	composition, 10	ALB	EB
R9116	0236 7830	174K, ±1%	CGW	N20
R9117	0229 9290	590K, ±1%	TEX	CD1/2PR
R9118 & R9119	0237 1800	31.6, ±1%, ¼W	TEX	CD1/4R
R9121 & R9122	0203 0040	composition, 15	ALB	EB
R9123 & R9124	0235 4450	composition, 200, ¼W	ALB	CB
R9126	0235 4180	composition, 15, ¼W	ALB	CB
R9127	0235 4320	composition, 56, ¼W	ALB	CB
R9200	0107 4380	variable, composition, 100K, ±20%, .2W (COARSE DC BAL)	CTS	Series 70
R9201	0229 4700	1M, ±1%	TEX	CD1/2PR
R9202	0109 2050	variable, composition, 100K, ±20%, .2W (FINE DC BAL)	CTS	Series 70
R9203	0203 1360	composition, 4.7M	ALB	EB
R9204	0234 8430	8.2K	CGW	C-20
R9205	0203 1610	composition, 47, ±10%	ALB	EB
R9206	0235 5090	composition, 100K, ¼W	ALB	CB
R9207	0235 6590	composition, 100, ±20%, ¼W	ALB	CB
R9208	0236 6750	13K, ±1%	CGW	N-20
R9209	0235 6590	composition, 100, ±20%, ¼W	ALB	CB
R9210	0229 4700	1M, ±1%	TEX	CD1/2PR
R9211	0236 6750	13K, ±1%	CGW	N-20
R9212	0107 2657	variable, composition, 10K, ±20%, ¼W (GAIN CAL)	ABD	
R9213	0107 2842	variable, composition, 1.5K, ±20%, ¼W (VARIABLE)	ABD	
R9214	0236 5720	1.1K, ±1%	CGW	N-20
R9215	0237 1700	6.98K, ±1%, 1W	CGW	N-25
R9216	0236 5720	1.1K, ±1%	CGW	N-20
R9217	0203 1610	composition, 47, ±10%	ALB	EB
R9218 & R9219	0236 5980	2.05K, ±1%	CGW	N-20
R9220 & R9221	0236 5810	1.37K, ±1%	CGW	N-20
R9222	0236 6930	20K, ±1%	CGW	N-20
R9223	0235 4240	composition, 27, ¼W	ALB	CB
R9224	0236 6930	20K, ±1%	CGW	N-20
R9225	0235 4240	composition, 27, ¼W	ALB	CB
R9226	0203 0160	composition, 47 (GAIN ADJ)	ALB	EB
R9227 & R9228	0236 5010	200, ±1%	CGW	C-20
R9230	0234 9030	820, 1W	CGW	C-32
R9233	0236 3090	200K	CGW	C-20
R9234 F/C/R	0107 2801	variable, composition, 100K/ 100K/1K, ±20% (POSITION/ ATTEN BAL)	ABD	
R9236	0236 3090	200K	CGW	C-20
R9237 & R9238	0234 9260	7.5K, 1W	CGW	C-32
R9241	0235 4900	composition, 16K, ¼W (Delay Line Option)	ALB	CB
R9242	0235 9650	2.74K, ±1%	CGW	NI-20
R9243 & R9244	0235 8500	221, ±1%	CGW	NI-20
R9245	0235 5070	composition, 82K, ¼W	ALB	CB
R9246	0235 9650	2.74K, ±1%	CGW	NI-20

Symbol	Part Number	Description	Recommended Vendor Code	Type
R9247	0236 0520	17.4K, ±1%	CGW	NI-20
R9248	0235 9500	2K, ±1%	CGW	NI-20
R9249	0203 2400	composition, 470, ±20%	ALB	EB
R9250	0235 5810	composition, 47, ±10%, ¼W	ALB	CB
R9251	0235 5780	composition, 27, ±10%, ¼W	ALB	CB
R9252	0235 5810	composition, 47, ±10%, ¼W	ALB	CB
R9253	0235 5780	composition, 27, ±10%, ¼W	ALB	CB
R9254	0234 9640	300K, 1W	CGW	C-32
R9255 & R9256	0203 2190	composition, 3.3M, ±10%	ALB	EB
R9257	0234 9640	300K, 1W	CGW	C-32
R9258 & R9259	0236 1620	200K, ±1%	CGW	NI-20
R9261	0203 1480	composition, 15M	ALB	EB
R9300	0107 4380	variable, composition, 100K, ±20%, .2W (COARSE DC BAL)	CTS	Series 70
R9301	0229 4700	1M, ±1%	TEX	CD1/2PR
R9302	0109 2050	variable, composition, 100K, ±20%, .2W (FINE DC BAL)	CTS	Series 70
R9303	0203 1360	composition, 4.7M	ALB	EB
R9304	0234 8430	8.2K	CGW	C-20
R9305	0203 1610	composition, 47, ±10%	ALB	EB
R9306	0235 5090	composition, 100K, ¼W	ALB	CB
R9307	0235 6590	100, ±20%, ¼W	ALB	CB
R9308	0236 6750	13K, ±1%	CGW	N-20
R9309	0235 6590	composition, 100, ±20%, ¼W	ALB	CB
R9310	0229 4700	1M, ±1%	TEX	CD1/2PR
R9311	0236 6750	13K, ±1%	CGW	N-20
R9312	0107 2657	variable, composition, 10K, ±20%, ¼W (GAIN CAL)	ABD	
R9313	0107 2842	variable, composition, 1.5K, ±20%, ¼W (VARIABLE	ABD	
R9314	0236 5720	1.1K, ±1%	CGW	N-20
R9315	0237 1700	6.98K, ±1%, 1W	CGW	N-25
R9316	0236 5720	1.1K, ±1%	CGW	N-20
R9317	0203 1610	composition, 47, ±10%	ALB	EB
R9318 & R9319	0236 5980	2.05K, ±1%	CGW	N-20
R9320 & R9321	0236 5810	1.37K, ±1%	CGW	N-20
R9322	0236 6930	20K, ±1%	CGW	N-20
R9323	0235 4240	composition, 27, ¼W	ALB	CB
R9324	0236 6930	20K, ±1%	CGW	N-20
R9325	0235 4240	composition, 27, ¼W	ALB	CB
R9326	0203 0160	composition, 47	ALB	EB
R9327 & R9328	0236 5010	200, ±1%	CGW	N-20
R9330	0234 9030	820, 1W	CGW	C-32
R9333	0236 3090	200K	CGW	C-20
R9334 F/C/R	0107 2801	variable, composition, 100K/ 100K/1K, ±20% (POSITION/ ATTEN BAL)	ABD	
R9336	0236 3090	200K	CGW	C-20
R9337 & R9338	0234 9260	7.5K, 1W	CGW	C-32
R9341	0235 4900	composition, 16K, ¼W (Delay Line Option)	ALB	CB
R9343 & R9344	0235 8500	221, ±1%	CGW	NI-20
R9345	0235 5070	82K, ¼W	ALB	CB
R9347	0236 0520	17.4K, ±1%	CGW	NI-20
R9350	0235 5810	composition, 47 ±10%, ¼W	ALB	CB
R9351	0235 5780	composition, 27, ±10%, ¼W	ALB	CB
R9352	0235 5810	composition, 47, ±10%, ¼W	ALB	CB
R9353	0235 5780	composition, 27, ±10%, ¼W	ALB	CB
R9358 & R9359	0236 1620	200K, ±1%	CGW	NI-20
R9401	0203 1580	composition, 27, ±10%	ALB	EB
R9402	0203 0300	composition, 180	ALB	EB
R9405 & R9406	0234 8450	10K	CGW	C-20
R9407 & R9408	0203 0120	composition, 33	ALB	EB
R9409	0234 9150	2.7K, 1W	CGW	C-32
R9410	0234 8450	10K, ±1%	CGW	C-20
R9411	0234 9150	2.7K, 1W	CGW	C-32

Symbol	Part Number	Description	Recommended Vendor Code	Type
R9412	0203 1580	composition, 27, ±10%	ALB	EB
R9413 & R9414	0236 4760	110, ±1%	CGW	N-20
R9415	0236 9590	1.1K, ±2%, 2W	CGW	C42F
R9416	0236 5980	2.05K, ±1%	CGW	N-20
R9417	0236 6560	8.25K, ±1%	CGW	N-20
R9418	0236 7070	28K, ±1%	CGW	N-20
R9419	0234 8450	10K	CGW	C-20
R9420	0203 1580	composition, 27, ±10%	ALB	EB
R9421	0236 5210	324, ±1%	CGW	N-20
R9422	0236 7070	28K, ±1%	CGW	N-20
R9423	0236 5980	2.05K, ±1%	CGW	N-20
R9424	0203 1580	composition, 27, ±10%	ALB	EB
R9425	0236 6560	8.25K, ±1%	CGW	N-20
R9426	0235 5730	composition, 10, ±10%, ¼W	ALB	CB
R9427 & R9428	0235 2340	3.6K, ±2%, 1W	CGW	C-32
R9429	0230 4170	768, ±1%, 4W	CGW	SI-30
R9430 & R9431	0235 4300	composition, 47, ¼W	ALB	CB
R9432	0237 1110	15K, 2W	CGW	C42S
R9433	0203 0580	composition, 2.7K	ALB	EB
R9434	0230 4180	3.24K, ±1%, 4W	CGW	SI-30
R9436	0236 5040	215, ±1%	CGW	NI-20
R9437	0230 4180	3.24K, ±1%, 4W	CGW	SI-30
R9438	0237 1110	15K, 2W	CGW	C42S
R9440	0203 1580	composition, 27, ±10%	ALB	EB
R9441	0230 4170	768, ±1%, 4W	CGW	SI-30
R9442	0235 5730	composition, 10, ±10%, ¼W	ALB	CB
R9443 & R9444	0203 2190	composition, 3.3M, ±10%	ALB	EB
R9445	0203 0760	composition, 15K	ALB	EB
R9446	0234 8510	18K, ±1%	CGW	C-20
R9447	0234 8560	30K, ±1%	CGW	C-20
R9450	0235 4170	composition, 13, ¼W	ALB	CB
R9501	0234 8120	430	CGW	C-20
R9502	0234 9350	18K, 1W	CGW	C-32
R9503	0106 3360	variable, composition, 25K, ±10% (TRIG DC LEVEL)	CTS	Series 65
R9504	0234 9350	18K, 1W	CGW	C-32
R9505	0234 8470	12K	CGW	C-20
R9506	0236 7100	30.1K, ±1%	CGW	N-20
R9507	0234 8540	24K	CGW	C-20
R9508	0234 9110	1.8K, 1W	CGW	C-32
R9509	0234 8280	2K	CGW	C-20
R9510	0234 8470	12K	CGW	C-20
R9511	0236 0270	10K, ±1%	CGW	NI-20
R9512	0234 8400	6.2K	CGW	C-20
R9513	0234 8540	24K	CGW	C-20
R9514	0234 8280	2K	CGW	C-20
R9515	0234 8360	4.3K	CGW	C-20
R9516	0234 8660	75K	CGW	C-20
R9517	0234 8540	24K	CGW	C-20
R9518	0234 8520	20K	CGW	C-20
R9519	0234 8550	27K	CGW	C-20
R9520	0234 8600	43K	CGW	C-20
R9521	0234 8660	75K	CGW	C-20
R9522	0234 8430	8.2K	CGW	C-20
R9601	0203 2300	composition, 10, ±20%	ALB	EB
R9602	0203 3550	composition, 2K, 1W	ALB	GB
R9603	0203 0630	composition, 4.3K	ALB	EB
R9604	0235 4680	composition, 2K, ¼W	ALB	CB
R9605	0203 0870	composition, 43K	ALB	EB
R9606	0203 0760	composition, 15K	ALB	EB
R9607	0203 0630	composition, 4.3K	ALB	EB
R9608	0235 4680	composition, 2K, ¼W	ALB	CB
R9609	0203 0870	composition, 43K	ALB	EB
R9610	0203 0770	composition, 16K	ALB	EB
R9611	0203 0760	composition, 15K	ALB	EB
R9612	0203 3550	composition, 2K, 1W	ALB	GB
R9613	0203 3580	composition, 2.7K, 1W	ALB	GB
R9614	0203 0390	composition, 430	ALB	EB
R9615 & R9616	0203 0740	composition, 12K	ALB	EB
R9617	0203 3370	composition, 360, 1W	ALB	EB
R9701	0236 0060	6.81K, ±1%	CGW	NI-20
R9702	0234 9170	3.3K, 1W	CGW	C-32

Symbol	Part Number	Description	Recommended Vendor Code	Type
R9703	0234 8430	8.2K	CGW	C-20
R9704	0234 8630	56K	CGW	C-20
R9705	0234 8570	33K	CGW	C-20
R9706	0234 8630	56K	CGW	C-20
R9707	0234 9170	3.3K, 1W	CGW	C-32
R9708	0234 9110	1.8K, 1W	CGW	C-32
R9709	0203 0070	composition, 20	ALB	EB
R9710	0235 4310	composition, 51, ¼W	ALB	CB
R9711	0203 1530	composition, 10, ±10%	ALB	EB
R9712	0235 9190	976, ±1%	CGW	NI-20
R9713	0234 8430	8.2K	CGW	C-20
R9714	0235 9970	5.62K, ±1%	CGW	NI-20
R9715	0236 0470	15.8K, ±1%	CGW	NI-20
R9716	0236 0510	16.9K, ±1%	CGW	NI-20
R9717	0235 1580	8.45K, ±1%	CGW	NI-20
R9718	0234 8340	3.6K	CGW	C-20
R9719	0235 9600	2.49K, ±1%	CGW	NI-20
R9720	0203 0530	composition, 1.6K	ALB	EB
R9721	0236 0690	24.9K, ±1%	CGW	NI-20
R9722	0234 8370	4.7K	CGW	C-20
R9801 & R9802	0239 1359	430, 2W	CGW	C-42
R9803	0203 0070	composition, 20	ALB	EB
R9804	0234 8260	1.6K	CGW	C-20
R9901	0229 4890	500K, ±1%	TEX	CD1/2PR
R9902	0229 4900	750K, ±1%	TEX	CD1/2PR
R9903	0229 4910	900K, ±1%	TEX	CD1/2PR
R9904	0229 9010	990K, ±1%	TEX	CD1/2PR
R9905	0235 0190	52.3, ±1%, ¼W	TEX	CD1/4R
R9906	0229 4700	1M, ±1%	TEX	CD1/2PR
R9907	0229 9040	333K, ±1%	TEX	CD1/2PR
R9908	0229 9050	111K, ±1%	TEX	CD1/2PR
R9909	0229 9080	10.1K, ±1%	TEX	CD1/2PR
R9911	0235 0140	105, ±1%, ¼W	TEX	CD1/4R
R9912	0235 0180	42.2, ±1%, ¼W	TEX	CD1/4R
R9913	0235 0190	52.3, ±1%, ¼W	TEX	CD1/4R
R9914	0235 0140	105, ±1%, ¼W	TEX	CD1/4R
R9915	0203 0000	composition, 10	ALB	EB
R9916	0236 7830	174K, ±1%	CGW	N-20
R9917	0229 9290	590K, ±1%	TEX	CD1/2PR
R9918 & R9919	0237 1800	31.6, ±1%, ¼W	TEX	CD1/4R
R9921 & R9922	0203 0040	composition, 15	ALB	EB
R9923 & R9924	0235 4550	composition, 200, ¼W	ALB	CB
R9926	0235 4180	composition, 15, ¼W	ALB	CB
R9927	0235 4320	composition, 56, ¼W	ALB	CB

SWITCHES

S910	0501 7212	rotary, 6 sections, 12 positions (VOLTS/DIV)	ABD	
S911	0501 7152	slide, 1 section, 5 positions (AC/DC/GND)	ABD	
S920	0501 7221	rotary, push-push (INVERT)	ABD	
S930	0501 7221	rotary, push-push (INVERT)	ABD	
S960	0501 6831	rotary, 1 section, 5 positions (MODE)	ABD	
S990	0501 7212	rotary, 6 sections, 12 positions (VOLTS/DIV)	ABD	
S991	0501 7152	slide, 1 section, 5 positions (AC/DC/GND)	ABD	

ELECTRON TUBES

V920 & V921	2501 4060	8056	RCA	Nuvistor
V930 & V931	2501 4060	8056	RCA	Nuvistor

NETWORKS

Z9401 & Z9402	8800 2422	peaking	ABD	
Type 7001 Delay Line	8901 6791		ABD	

NOTES

SECTION 6B
SPARE PARTS LIST

SPARE PARTS REQUIREMENTS

a. General

The Type 76-02A Dual Trace Plug-in is an extremely reliable and dependable instrument. Only components thoroughly tested and approved by the engineers of the Quality Assurance Laboratory are used in this instrument. Continued performance tests, environmental and life testing of production units make certain your oscilloscope will give many years of satisfactory service. These new Fairchild oscilloscopes are precision engineered and require no selected parts.

Two lists of "running spares" are included to aid you in periodic maintenance. The running-spare parts lists include recommended quantities and reference symbol numbers. Section 6A of this Instruction Manual gives a complete listing of all components and their recommended vendors so that you may readily procure them from a local supply house or your own stores.

Note: The local Fairchild Scientific Instrument Field Engineering representative and his service organization can assist you in obtaining any additional components in the shortest possible time. To help expedite service, always give the Type Number and Serial Number of the instrument; always specify the part number and give a description of the component (see Section 6A of this manual).

b. 500-Hour Spares (6 months)

The recommended list for one through three units follows.

Electron Tubes

Symbol	Quantity
V920	2

Transistors

Q9200	2
Q9202	4
Q9400	2
Q9406	4
Q9408	1
Q9413	3
Q9504	1
Q9703	1

Diodes

CR9200 (FD841)	8

Lamps

DS9501	1

c. 2000-Hour Spares (2 years)

The recommended list for one through five units is given below. Maintain spares indicated plus one for each oscilloscope in use; 2 of each set of the 500-hour spare list given in paragraph (b) plus the quantities listed as follows:

Capacitors

Symbol	Quantity	Symbol	Quantity
C9101	3	C9213	2
C9102	3	C9215	1
C9106	2	C9218	1
C9109	1	C9221	1
C9111	1	C9407	2
C9112	1	C9414	1
C9113	1	C9417	1
C9114	2	C9418	1
C9115	1	C9419	1
C9117	1	C9501	1
C9200	8	C9505	3
C9102	1	C9602	1
C9202	7	C9603	1
C9206	2	C9606	1
C9207	1	C9702	1
C9208	1	C9703	1
C9209	3	C9707	1
C9212	1		

Lamps

Symbol	Quantity
DS9501	1

Hybrid Coil

HY9202	8

Electrical Connectors

J9101	1
J9103	1
P9001	1

section 6b — spare parts list

Resistors

Symbol	Quantity	Symbol	Quantity
R9101	1	R9418	1
R9102	1	R9421	1
R9103	1	R9426	1
R9104	1	R9427	1
R9105	2	R9429	1
R9106	3	R9430	1
R9107	1	R9432	1
R9108	1	R9433	1
R9109	1	R9434	1
R9111	2	R9445	1
R9112	1	R9446	1
R9115	1	R9447	1
R9116	1	R9450	1
R9117	1		
R9118	2		
R9121	2	R9501	1
R9123	2	R9502	1
R9126	1	R9503	1
R9127	1	R9505	1
		R9506	1
		R9507	1
R9200	1	R9508	1
R9202	1	R9509	1
R9203	1	R9511	1
R9204	2	R9512	1
R9205	3	R9515	1
R9206	1	R9516	1
R9207	2	R9518	1
R9208	2	R9519	1
R9212	1	R9520	1
R9213	1		
R9214	2		
R9215	1	R9601	1
R9218	3	R9602	1
R9220	2	R9603	1
R9222	2	R9604	1
R9223	2	R9605	1
R9226	1	R9610	1
R9227	2	R9613	1
R9230	1	R9614	1
R9233	2	R9615	1
R9234	1	R9616	1
R9237	2	R9617	1
R9241	1		
R9242	1		
R9243	2	R9701	1
R9245	1	R9704	1
R9247	1	R9705	1
R9248	1	R9709	1
R9249	1	R9710	1
R9250	2	R9711	1
R9251	2	R9712	1
R9254	1	R9714	1
R9255	2	R9715	1
R9258	2	R9716	1
R9261	1	R9717	1
		R9718	1
		R9719	1
R9401	2	R9720	1
R9405	2	R9721	1
R9407	1	R9722	1
R9409	1		
R9413	1		
R9415	1	R9801	1
R9417	1	R9804	1

Switches

Stock only one for each of the following switches for each 3 units being maintained:

S910, S911, S920, S930, S960, S990, S991

Note: Should a particular switch receive more than normal use in certain applications, then the quantity stocked of that particular switch should be doubled.

Networks

Symbol	Quantity
Z9401	1

Type 7001 Delay Line (Option)

d. Miscellaneous

The following items may be stocked in quantities of one for each 2 units being maintained:

Name	Part Number
Connector, BNC	0905 7610
Jack, ground	0905 8500
Bushing, shaft (Gain Adj)	4301 3581
Knob, GP #2 (Volts/Div)	4500 8945
Knob, fastener	4501 0431
Knob, small (Variable)	4501 2232
Knob, small (Norm/Invert)	4501 2022
Knob, small (Position)	4501 2024

e. Summary

The quantities of spare parts given in the preceding paragraphs are intended for industrial and military duty under normal environment and heavy-use conditions. It is suggested that the maintenance engineer evaluate:

1. The conditions under which the instruments will be used.
2. The skill of the maintenance technicians.
3. Other similar items on hand.
4. The effect of procurement time of spares and effects of instrument down-time on your organization.

It is recommended that inventories of spare parts outlined above be adjusted according to the requirements of your own laboratory or plant.

In the first analysis, the factory recommends the availability of spares or standby equipments since extensive life testing of your instrument has shown no higher failure rate for any specific component.

LIST OF RECOMMENDED VENDORS

CODE	NAME
ABD	Allen B. Du Mont Laboratories
AER	Aerovox Corporation
AHH	Arrow-Hart & Hegeman Electric Company
ALB	Allen-Bradley Company
ALC	Allied Control
ALCO	Alco Electronic Products
ALD	Alden Products Company
AMA	Amaton Electronic Hardware
AMP	Amp Inc.
AMR	Amperite Company, Inc.
AMX	Amperex Electronics Products, Inc.
APC	American Phenolic Corporation
APH	Amphenol Electronics Corporation
ARC	Arco Electronics Inc. (Elmenco)
AST	Astron Corporation
BNS	Bourns Inc.
BUS	Bussmann Mfg. Company
CAN	Cannon Electric Company
CBS	CBS-Hytron Division of CBS
CDE	Cornell-Dubilier Electric Corporation
CGW	Corning Glass Works
CH	Cutler-Hammer, Inc.
CHC	Chester Cable Corporation
CHM	Chatham Electronics
CIN	Cinch Manufacturing Company
CLS	Clarostat Mfg. Co., Inc.
COC	Continental Carbon
COW	Continental-Wirt Electronics Corporation
CPC	C. P. Clare & Company
CRL	Centralab, Division of Globe-Union, Inc.
CST	Chicago Standard Transformer Corporation
CTC	Cambridge Thermionic Corporation
CTS	Chicago Telephone Supply Corporation
DAG	Dage Electronic Company, Inc.
DAL	Dale Products, Inc.
DLC	Dialight Corporation
DRK	Drake Mfg. Company
EBY	Hugh H. Eby, Inc.
EIA	Any manufacturer meeting EIA standards
ELC	Electra Manufacturing Company
ELD	Eldema Corporation
EMC	Electro Motive Mfg. Company
EMW	Elmwood Sensors, Inc.
ERC	Erie Resistor Corporation
ESX	Essex Electronics
FCI	Fairchild Camera and Instrument Corporation
FER	Ferroxcube Corporation of America
GDE	Good-All Electric Mfg. Company
GE	General Electric Company
GRC	General Radio Company
GRY	Grayhill, Inc.
GUD	The Gudeman Company
HOP	Hopkins Engineering Company
HWP	Hewlett-Packard Company
IRC	International Resistance Company
IRP	International Rectifier Corporation
ITT	ITT Components Division
JEF	Jeffers Electronics, Inc.
JHN	E. F. Johnson Company
JWM	J. W. Miller Company
KUL	Kulka Electric Mfg. Co. Inc.
KXM	Klixon Metals and Control Corporation
LEE	Leecraft Mfg. Company
LFI	Littlefuse, Inc.
MAL	P. R. Mallory & Company, Inc.
MIC	Micamold Electronics Mfg. Corporation
MIL	Miller Electric Company
MOT	Motorola Semiconductor Products, Inc.
MUC	Mucon Corporation
MUT	The Muter Company
NYT	New York Transformer Company, Inc.
OAK	Oak Mfg. Company
PHC	Philco Corporation
PHI	Philips Electronic Tube Division
PLS	Plastoid Corporation
POT	Potter & Brumfield, Inc.
PRC	Precision Resistor Co., Inc.
PYR	Pyramid Electric Company
RCA	Radio Corporation of America
RMC	Radio Materials Corporation
ROY	Royal Electric Corporation, Inc.
RTN	Rotron Mfg. Company
SIG	Signalite Inc.
SLT	Sealectro Corporation
SOL	Solitron Devices, Inc.
SPG	Sprague Electric Company
STC	Stackpole Carbon Company
STW	Standard Winding Company
SUM	Summit Coil Company
SWW	Stanwyck Winding Company
SYL	Sylvania Electric Products, Inc.
SYN	Syntronic Instruments, Inc.
TEC	Transistor Electronics Corporation
TEX	Texas Instruments, Inc.
THC	Thermal Control, Inc.
TOR	Torrington Mfg., Company
TRS	Tresco, Inc.
TRU	Tru-Ohm Products
TUG	Tung-Sol Electric Inc.
UCN	Ucinite Company
VIC	The Victoreen Instrument Company
WDE	Wood Electric Corporation
WDL	Ward Leonard Electric Company
WES	Weston Electrical Instrument Corporation
WYN	Welwyn International Inc.

INSTRUMENT WARRANTY AND SERVICE NOTICE

WARRANTY

The Scientific Instrument Department warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Fairchild, the Instrument is determined to be defective in workmanship or material, Fairchild will, subject to the conditions set forth below, either repair the defective part or replace it with a new part. Fairchild shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Fairchild be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Fairchild service organization or an employee thereof, or to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond, the continental limits of the United States.

This warranty shall, at Fairchild's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Fairchild or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

REGISTERING THE WARRANTY

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to the Instrument Service Department immediately upon receipt of the equipment. Complete information is necessary. BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD. Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is requested, please first contact the factory or authorized depot giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

FAIRCHILD
Du Mont Laboratories
Scientific Instruments Dept.
750 Bloomfield Avenue, Clifton, New Jersey

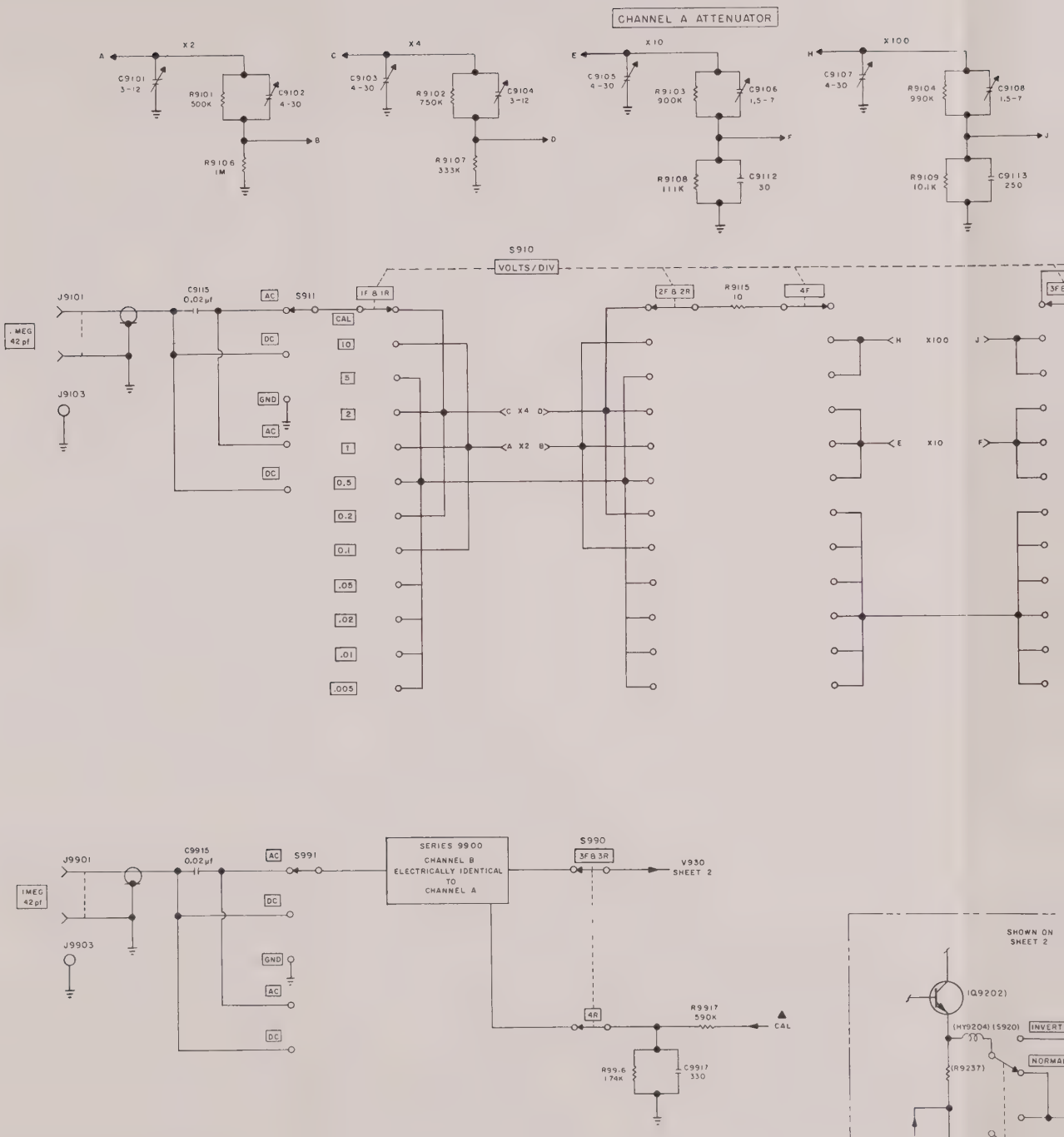
The Instrument Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

REPLACEMENT PARTS

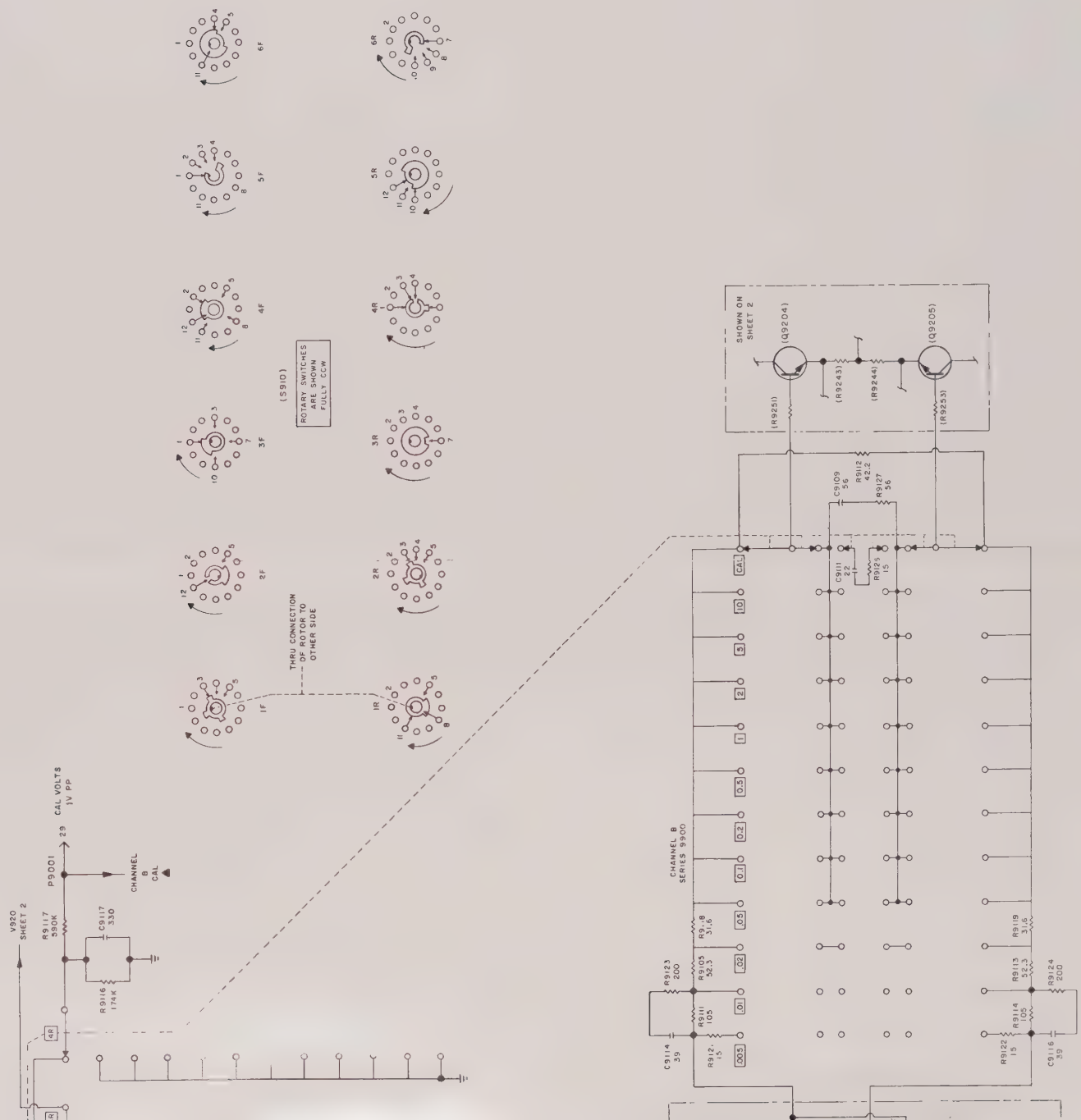
If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Fairchild part number for all electrical components used in the Instrument. This will help to expedite service.

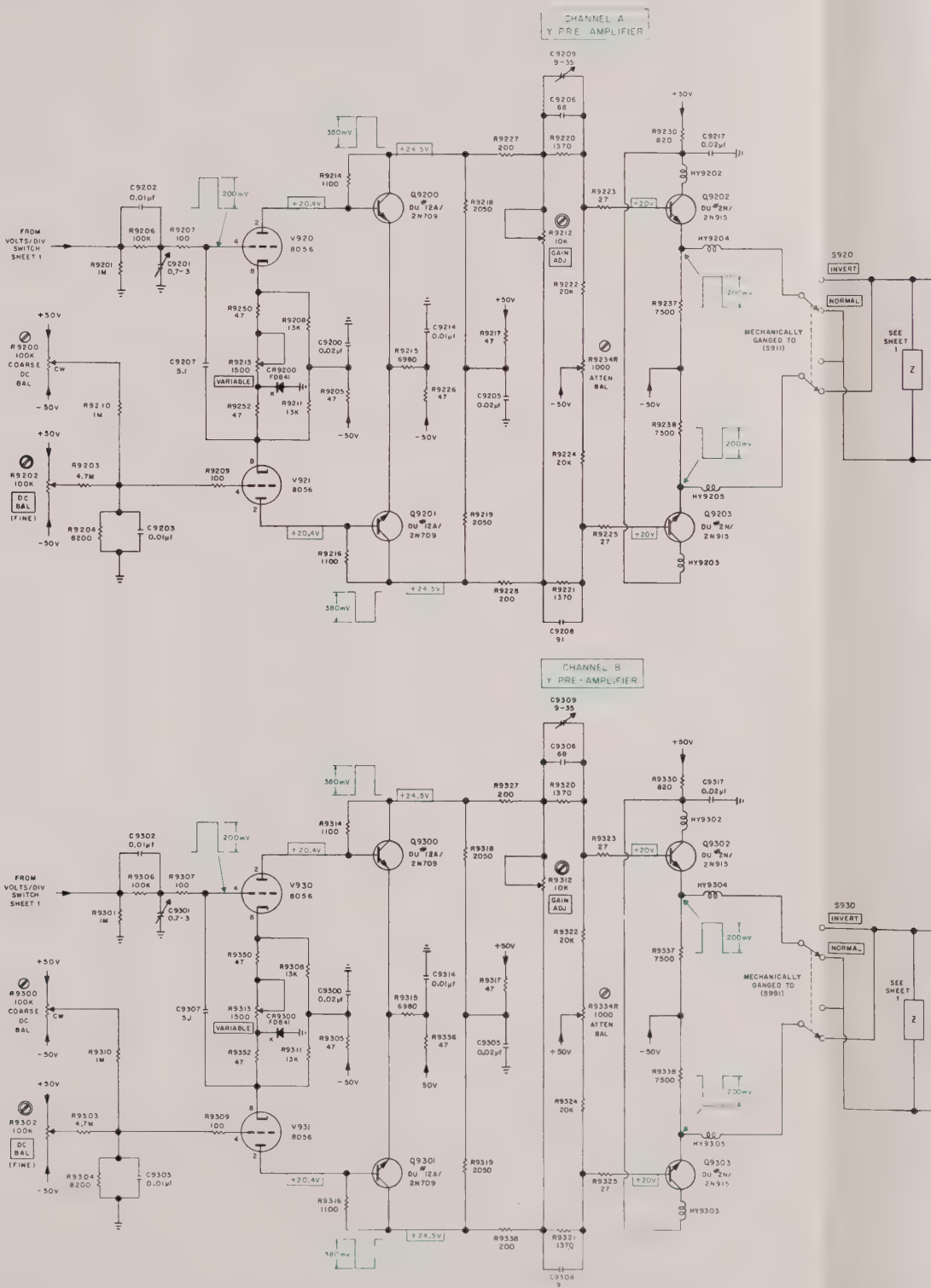
PATENT NOTICE

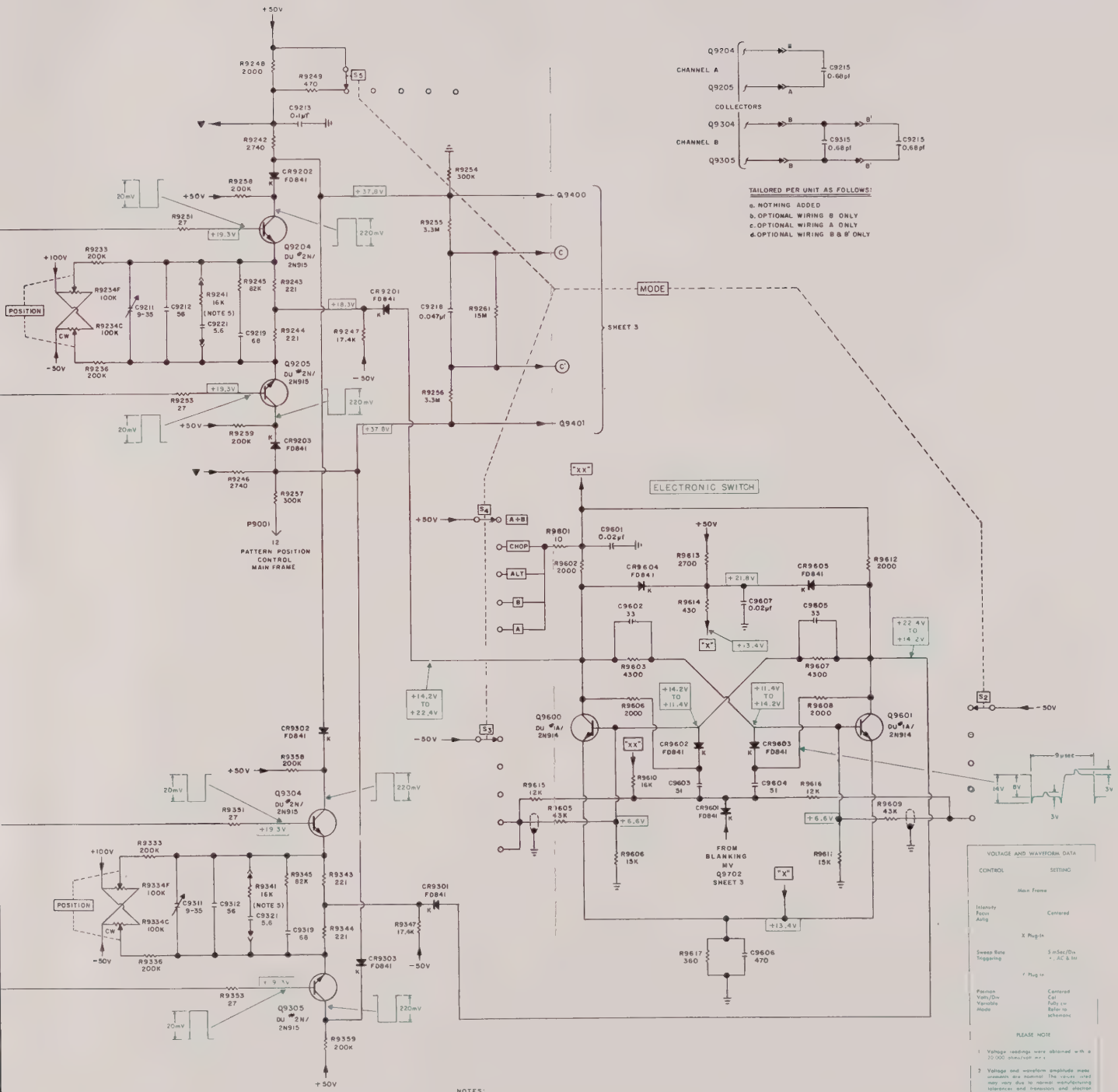
Manufactured under one or more U. S. Patents owned or controlled by Fairchild Camera and Instrument Corporation, 750 Bloomfield Avenue, Clifton, New Jersey, U.S.A. Patent Numbers supplied upon request.



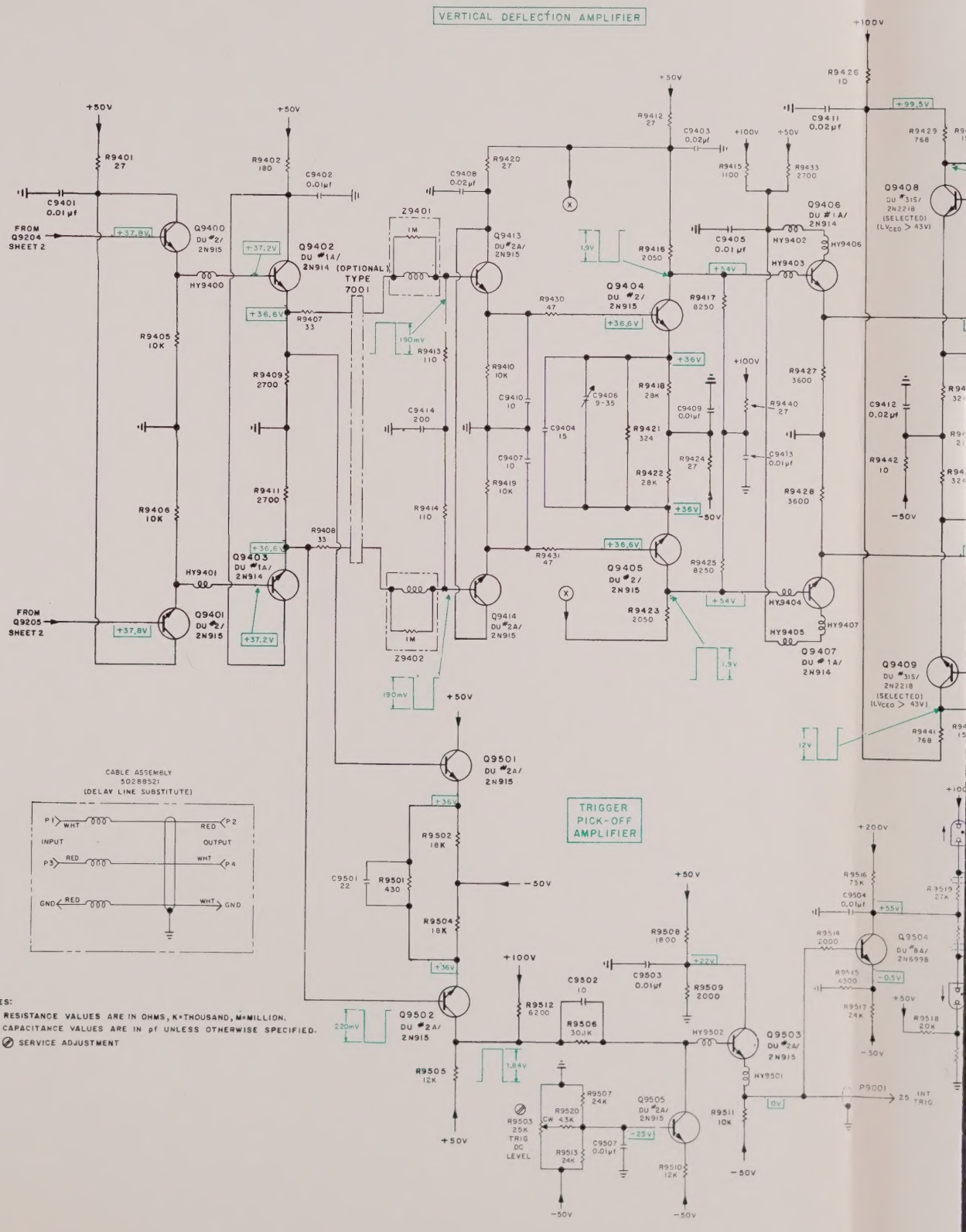
NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.

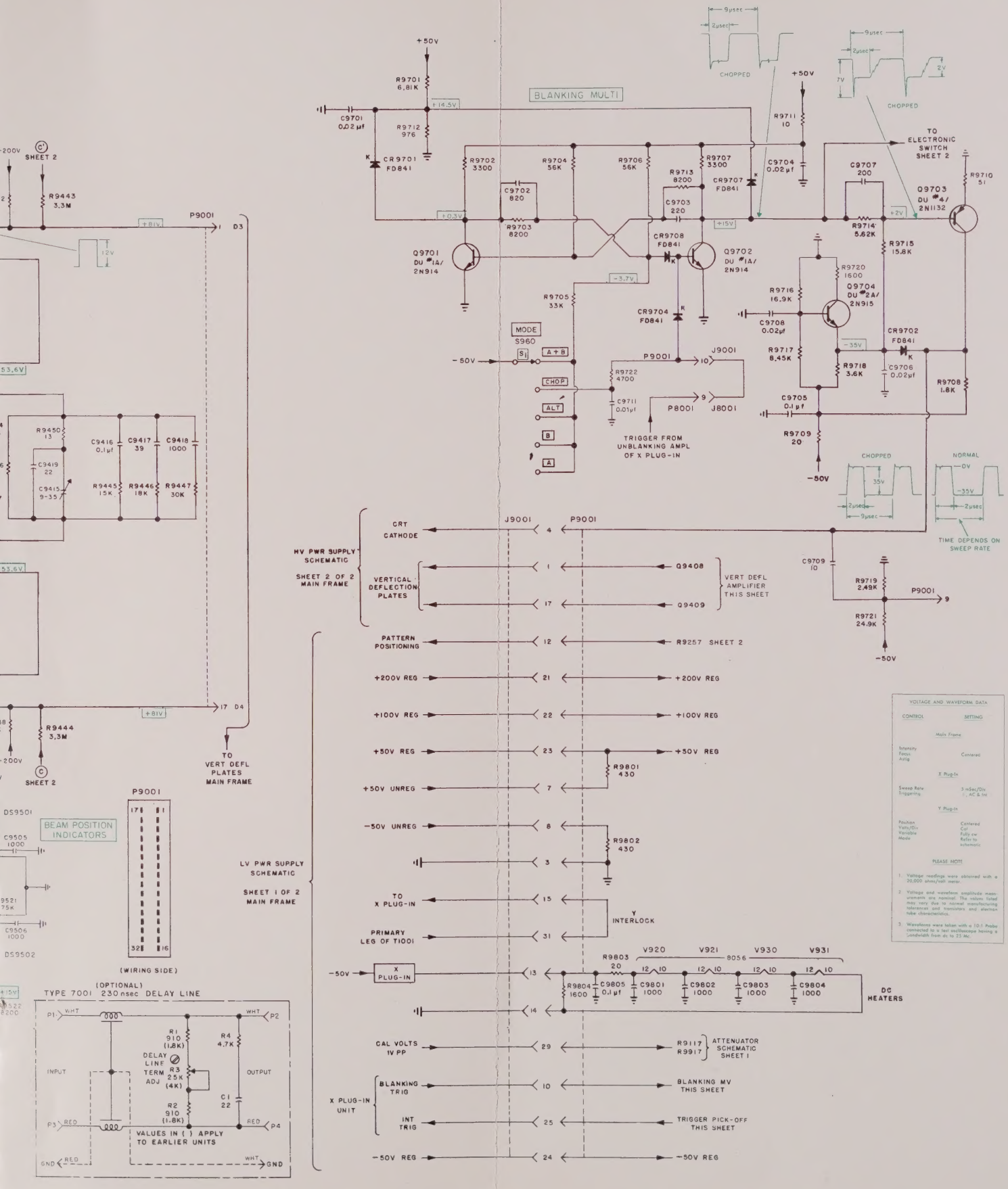

(S910)
ROTARY SWITCHES AS SHOWN FULL CCW
THRU CONNECTION OF ROTOR TO OTHER SIDE
1F
2F
3F
4F
5F
6F
1R
2R
3R
4R
5R
6R
V920 SHEET 2
P9001
CAL VOLTS 1V PP
CHANNEL B CAL
R9117 590K
C9117 330
R9116 174K
SHOWN ON SHEET 2
(Q9204)
(Q9205)
(R9243)
(R9244)
(R9251)
(R9253)
C9109 56
R9112 42.2
R9127 56
C9111 22
R9121 15
CHANNEL B SERIES 9900
R9123 200
R9105 52.3
R9111 105
R9112 15
C9114 39
R9118 31.6
R9119 31.6
R9113 52.3
R9114 105
R9122 15
C9116 39
R9124 200


CHANNEL A
Y PRE AMPLIFIER
FROM VOLTS/DIV SWITCH SHEET 1
R9201 1M
C9202 0.01µf
R9206 100K
R9207 100
C9201 0.7-3
V920 8056
R9250 47
R9208 13K
C9207 5µ
R9213 1500
VARIABLE
C9200 F0841
R9252 47
R9211 13K
C9200 0.02µf
R9205 47
R9210 1M
R9200 100K COARSE DC BAL
R9202 100K DC BAL (FINE)
R9203 4.7M
R9204 8200
C9203 0.01µf
R9209 100
V921 8056
R9214 1100
Q9200 DU 12A/ 2N709
R9215 6980
C9214 0.01µf
R9217 47
R9226 47
C9205 0.02µf
R9216 1100
Q9201 DU 12A/ 2N709
R9218 2050
R9219 2050
R9227 200
R9228 200
R9220 1370
R9212 10K GAIN ADJ
R9222 20K
R9224 20K
R9221 1370
C9208 91
C9209 9-35
C9206 68
R9223 27
R9225 27
R9230 820
C9217 0.02µf
HY9202
Q9202 DU 2N/ 2N915
HY9204
R9237 7500
R9238 7500
HY9205
Q9203 DU 2N/ 2N915
HY9203
R9234R 1000 ATTEN BAL
S920 INVERT NORMAL
MECHANICALLY GANGED TO (S911)
SEE SHEET 1
Z
380mV
200mV
+24.5V
+20.4V
+20V
+50V
-50V
CW
CHANNEL B
Y PRE-AMPLIFIER
FROM VOLTS/DIV SWITCH SHEET 1
R9301 1M
C9302 0.01µf
R9306 100K
R9307 100
C9301 0.7-3
V930 8056
R9350 47
R9308 13K
C9307 5µ
R9313 1500
VARIABLE
C9300 F0841
R9352 47
R9311 13K
C9300 0.02µf
R9305 47
R9310 1M
R9300 100K COARSE DC BAL
R9302 100K DC BAL (FINE)
R9303 4.7M
R9304 8200
C9303 0.01µf
R9309 100
V931 8056
R9314 1100
Q9300 DU 12A/ 2N709
R9315 6980
C9314 0.01µf
R9317 47
R9336 47
C9305 0.02µf
R9316 1100
Q9301 DU 12A/ 2N709
R9318 2050
R9319 2050
R9327 200
R9328 200
R9320 1370
R9312 10K GAIN ADJ
R9322 20K
R9324 20K
R9321 1370
C9308 9
C9309 9-35
C9306 68
R9323 27
R9325 27
R9330 820
C9317 0.02µf
HY9302
Q9302 DU 2N/ 2N915
HY9304
R9337 7500
R9338 7500
HY9305
Q9303 DU 2N/ 2N915
HY9303
R9334R 1000 ATTEN BAL
S930 INVERT NORMAL
MECHANICALLY GANGED TO (S991)
SEE SHEET 1
Z
380mV
200mV
+24.5V
+20.4V
+20V
+50V
-50V
50V
CW



NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
4. ⊘ SERVICE ADJUSTMENT.
5. (OPTIONAL WIRING) MAY BE REMOVED WITH DELAY LINE IF REQUIRED


VERTICAL DEFLECTION AMPLIFIER
TRIGGER PICK-OFF AMPLIFIER
FROM Q9204 SHEET 2
FROM Q9205 SHEET 2
Q9400 DU #2/ 2N915
Q9401 DU #2/ 2N915
Q9402 DU #1A/ 2N914 (OPTIONAL) TYPE 7001
Q9403 DU #1A/ 2N914
Q9404 DU #2/ 2N915
Q9405 DU #2/ 2N915
Q9406 DU #1A/ 2N914
Q9407 DU #1A/ 2N914
Q9408 DU #315/ 2N2218 (SELECTED) (LVCEO > 45V)
Q9409 DU #315/ 2N2218 (SELECTED) (LVCEO > 45V)
Q9413 DU #2A/ 2N915
Q9414 DU #2A/ 2N915
Q9501 DU #2A/ 2N915
Q9502 DU #2A/ 2N915
Q9503 DU #2A/ 2N915
Q9504 DU #8A/ 2N6998
Q9505 DU #2A/ 2N915
Z9401
Z9402
HY9400
HY9401
HY9402
HY9403
HY9404
HY9405
HY9406
HY9407
HY9501
HY9502
CABLE ASSEMBLY 50288521 (DELAY LINE SUBSTITUTE)
INPUT
OUTPUT
P1
P2
P3
P4
GND
WHT
RED
NOTES:
1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT
P3001
25 INT TRIG


BLANKING MULTI
+50V
R9701 6.81K
+14.5V
C9701 0.02 µf
R9712 976
CR9701 FD841
R9702 3300
R9704 56K
R9706 56K
R9707 3300
R9713 8200
CR9707 FD841
C9702 820
C9703 220
R9703 8200
+0.3V
+15V
Q9701 DU *1A/ 2N914
Q9702 DU *1A/ 2N914
CR9708 FD841
-3.7V
R9705 33K
CR9704 FD841
MODE S960
S1
A+B
CHOP
ALT
B
A
-50V
P9001
J9001
P8001
J8001
R9722 4700
C9711 0.01µf
TRIGGER FROM UNBLANKING AMPL OF X PLUG-IN
R9711 10
C9704 0.02 µf
TO ELECTRONIC SWITCH SHEET 2
C9707 200
R9710 51
Q9703 DU *4/ 2N1132
+2V
R9714 5.62K
R9715 15.8K
R9720 1600
R9716 16.9K
Q9704 DU *2A/ 2N915
C9708 0.02µf
-35V
R9717 8.45K
R9718 3.6K
CR9702 FD841
C9706 0.02µf
R9708 1.8K
C9705 0.1 µf
R9709 20
-50V
9µsec
2µsec
CHOPPED
7V
2V
NORMAL
0V
-35V
35V
TIME DEPENDS ON SWEEP RATE
C9709 10
R9719 2.49K
R9721 24.9K
P9001
HV PWR SUPPLY SCHEMATIC
SHEET 2 OF 2 MAIN FRAME
CRT CATHODE
VERTICAL DEFLECTION PLATES
Q9408
Q9409
VERT DEFL AMPLIFIER THIS SHEET
PATTERN POSITIONING
R9257 SHEET 2
+200V REG
+100V REG
+50V REG
+50V UNREG
-50V UNREG
R9801 430
R9802 430
LV PWR SUPPLY SCHEMATIC
SHEET 1 OF 2 MAIN FRAME
TO X PLUG-IN
Y INTERLOCK
PRIMARY LEG OF T1001
X PLUG-IN
R9803 20
V920
V921
V930
V931
8056
R9804 1600
C9805 0.1 µf
C9801 1000
C9802 1000
C9803 1000
C9804 1000
DC HEATERS
CAL VOLTS IV PP
R9117
R9917
ATTENUATOR SCHEMATIC SHEET 1
X PLUG-IN UNIT
BLANKING TRIG
BLANKING MV THIS SHEET
INT TRIG
TRIGGER PICK-OFF THIS SHEET
-50V REG
VOLTAGE AND WAVEFORM DATA
CONTROL
SETTING
Main Frame
Intensity
Focus
Astig
Centered
X Plug-In
Sweep Rate
Triggering
5 mSec/Div
AC & Int
Y Plug-In
Position
Volts/Div
Variable
Mode
Centered
Cal
Fully cw
Refer to schematic
PLEASE NOTE
1. Voltage readings were obtained with a 20,000 ohms/volt meter.
2. Voltage and waveform amplitude measurements are nominal. The values listed may vary due to normal manufacturing tolerances and transistors and electron tube characteristics.
3. Waveforms were taken with a 10:1 Probe connected to a test oscilloscope having a bandwidth from dc to 25 Mc.
+200V
C'
SHEET 2
R9443 3.3M
+81V
P9001
1 D3
12V
53.6V
R9450 13
C9416 0.1µf
C9417 39
C9418 1000
C9419 22
C9415 9-35
R9445 15K
R9446 18K
R9447 30K
17 D4
R9444 3.3M
TO VERT DEFL PLATES MAIN FRAME
BEAM POSITION INDICATORS
DS9501
C9505 1000
C9506 1000
DS9502
(WIRING SIDE)
(OPTIONAL)
TYPE 7001 230 nsec DELAY LINE
P1
P2
P3
P4
WHT
RED
GND
R1 910 (1.8K)
R4 4.7K
DELAY LINE TERM ADJ
R3 25K (4K)
R2 910 (1.8K)
C1 22
INPUT
OUTPUT
VALUES IN ( ) APPLY TO EARLIER UNITS

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